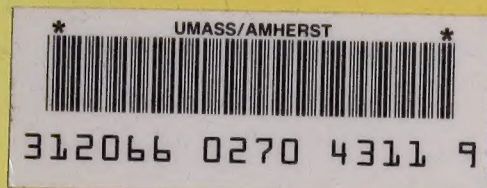


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CENTRAL ARTERY/TUNNEL PROJECT

FHWA-MA-EIS-82-02-DS3

EOEA #4325



CHARLES RIVER CROSSING

Draft

SUPPLEMENTAL

ENVIRONMENTAL IMPACT STATEMENT/REPORT



Existing Charles River Crossing Area – Boston, Massachusetts



Federal Highway Administration
Massachusetts Highway Department



July 1993

Charles River Crossing

**CENTRAL ARTERY/TUNNEL PROJECT
BOSTON, MASSACHUSETTS**

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/REPORT

[v.1]

Submitted Pursuant to 42 U.S.C. 4332(2) (C)
(and where applicable, 49 U.S.C. 303)

by the
U.S. Department of Transportation, Federal Highway Administration
and
Massachusetts Highway Department

Cooperating Agencies

U.S. Advisory Council on Historic Preservation
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Department of the Interior
Fish and Wildlife Service
National Park Service
Geological Survey
U.S. Environmental Protection Agency
Federal Aviation Administration
Federal Transit Administration
National Marine Fisheries Service
Massachusetts Bay Transportation Authority
Massachusetts Port Authority
Massachusetts Turnpike Authority
Massachusetts Aeronautics Commission

Massachusetts Water Resources Authority
Massachusetts Historical Commission
Massachusetts Executive Office of Environmental Affairs
Department of Environmental Management
Department of Environmental Protection
Metropolitan District Commission
Dept. of Fisheries, Wildlife, and Env. Enforcement
Division of Marine Fisheries
Coastal Zone Management
Metropolitan Area Planning Council
City of Boston
Boston Conservation Commission
Boston Water and Sewer Commission
City of Cambridge
Cambridge Conservation Commission
City of Somerville

July 16, 1993
Date of Approval

July 16, 1993
Date of Approval

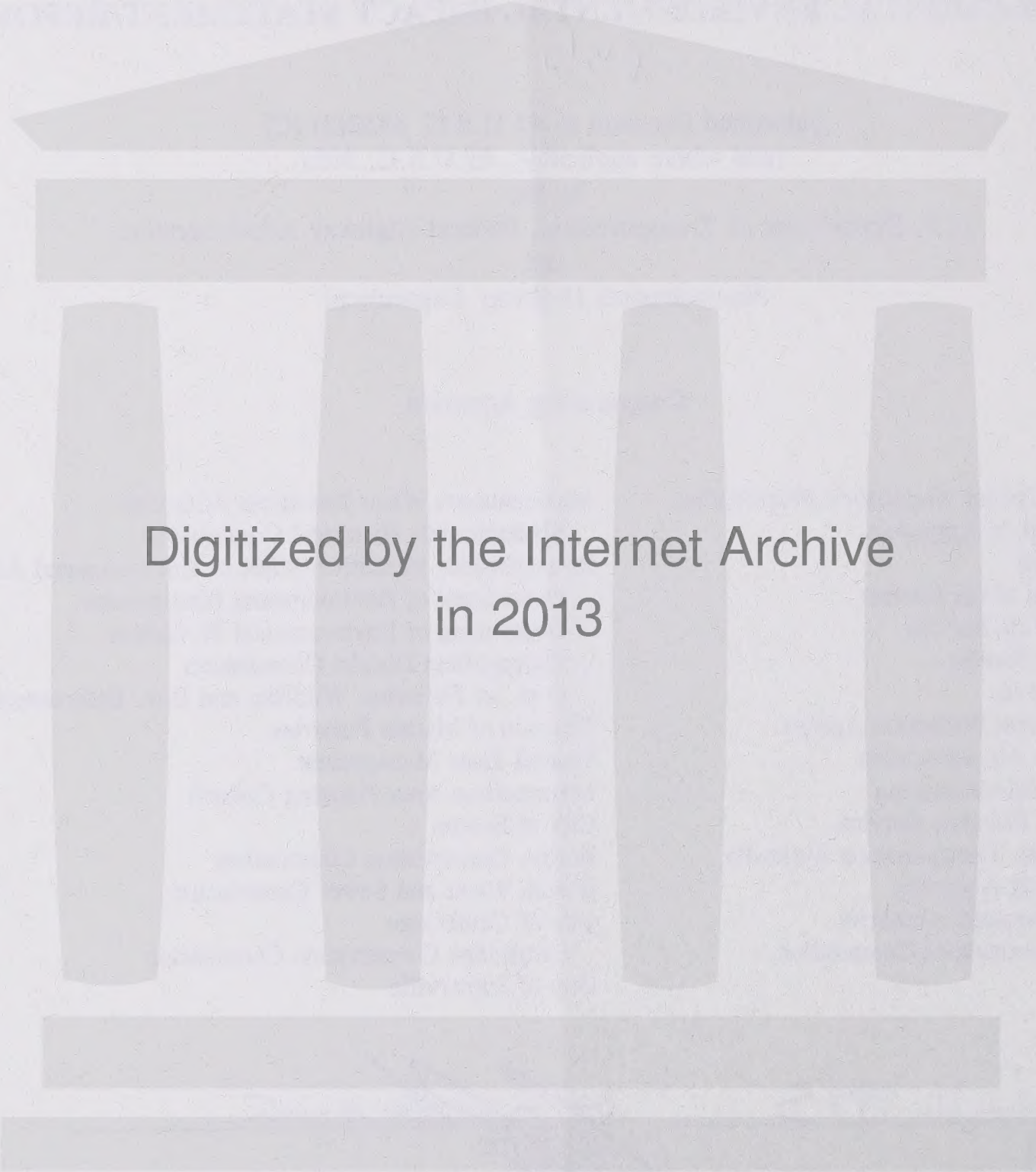
July 16, 1993
Date of Approval

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For EOTC

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For MHD

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For FHWA

This is a Supplement to FHWA-MA-EIS-82-02-F and EOEA No. 4325. This Supplement describes the Charles River Crossing portion of the Central Artery/Tunnel Project and its impacts on the Area North of Causeway Street Project subarea.



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CENTRAL ARTERY/TUNNEL PROJECT
BOSTON, MASSACHUSETTS
CHARLES RIVER CROSSING
DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/REPORT
FHWA - MA - EIS - 82 - 02 - DS3
EOEA #4325

Submitted by the Massachusetts Highway Department

Prepared by Bechtel/Parsons Brinckerhoff

July 1993

This is a Supplement to FHWA-MA-EIS-82-02-FS2 and EOEA #4325. This Supplement describes the Charles River Crossing portion of the Central Artery/Tunnel Project and its impacts on the Area North of Causeway Street.



CHARLES RIVER CROSSING

Draft SUPPLEMENTAL

ENVIRONMENTAL IMPACT STATEMENT/REPORT



Federal Highway Administration
Massachusetts Highway Department



July 1993

Executive Summary

Charles River Crossing Draft Supplemental Environmental Impact Statement/Report Draft Section 4(f) Evaluation

- **Introduction**

The Massachusetts Highway Department (MHD) and the Federal Highway Administration (FHWA) have prepared this Charles River crossing Draft Supplemental Environmental Impact Statement/Report (DSEIS/R), for the Area North of Causeway Street subarea of the Central Artery/Tunnel Project (the Project) in Boston and Cambridge. A Draft 4(f) Evaluation is published at the end of the DSEIS/R.

This DSEIS/R describes three new design alternatives for the Charles River crossing. It compares the potential environmental impacts of each of the design alternatives to those of Scheme Z and to those of the other new alternatives. The three new alternatives include Alternative 8.1D Modified 5 (8.1D Mod 5), as described in the Notice of Project Change (NPC) submitted to the Executive Office of Environmental Affairs (EOEA) and the United States Department of Transportation Federal Highway Administration (FHWA) on September 30, 1992, and two subsequent revisions to Alternative 8.1D Mod 5, known as the Reduced River-Tunnel Alternative and the Non-River-Tunnel Alternative. The purpose in considering the new design alternatives is to reduce aesthetic and other environmental impacts associated with Scheme Z, the approved Proposed Action in the 1991 FSEIS/R. The three new design alternatives seek to balance the competing goals of reducing environmental and aesthetic impacts of the highway design, while maximizing traffic operational efficiency and maintaining appropriate levels of safety.

The Charles River crossing is needed to link regional highway facilities on the south side of the river to the essential regional connections on the north side of the river and to complete all necessary local connections to these facilities.

- **Major Policy Issues Affecting The Charles River Crossing**

The following discussion briefly summarizes the major policy issues articulated throughout this two-year reevaluation of the Charles River crossing.

Scheme Z remains the Proposed Action for the Project in the Area North of Causeway Street unless and until a new design for the Charles River crossing is approved. The three new design alternatives under consideration are intended to further reduce the environmental and aesthetic impacts of Scheme Z, while maintaining its level of improvement in regional traffic service.

Scheme Z provides acceptable traffic operations for the Project. Furthermore, the Scheme Z design was approved in concept during the 1991 environmental review process by agencies having jurisdiction over parklands, historic, and wetland issues. These issues constitute key environmental impact categories for any new highway crossing of the Charles River. The overall impacts associated with Scheme Z led MHD to engage in an effort to further reduce its environmental and aesthetic impacts through a broad public participation process requested by the Secretary of the EOEA.

In attempting to reduce the impacts of the Charles River crossing, MHD has developed three new design alternatives which seek to balance a variety of key concerns, including specific regulatory mandates regarding protection of parklands, historic resources, and wetlands, as well as considerations of

aesthetics, traffic capacity, and safety. These issues have guided the evaluation of the three new design alternatives and will continue to be important in the selection of a preferred alternative.

Environmental And Aesthetic Impacts. The most direct means of reducing aesthetic impacts of the Charles River crossing is to replace above-ground structures with tunnels. The three new design alternatives assessed in the DSEIS/R examine whether a viable solution, using land-based tunnels, and in two alternatives, river tunnels, can be achieved.

Reduction in the mass of the Scheme Z loop ramps and relocation of the loop ramps away from the river's edge have been a primary focus of the Charles River crossing redesign effort. Each of the three new design alternatives succeeds in reducing the mass of these loop ramp structures. In addition, none of the three new design alternatives has loop ramps which are situated closer than 120 feet away from the river's edge at their nearest point. Each of the three new design alternatives also results in a reduction in the width of bridge structure.

These aesthetic and open space improvements raise a corresponding series of new issues. For example, reducing the mass of loop ramps structures leads to the inclusion of a new signalized intersection in all of the three new design alternatives. Construction of this intersection requires placement of fill in the northern portion of the Millers River. River tunnel construction employed in two of the three new design alternatives also poses aquatic impacts not present under Scheme Z or under the Non-River-Tunnel Alternative. These aquatic impacts must be reviewed under the applicable regulatory framework to determine if they can be avoided. If not, the extent to which they can be successfully mitigated and the extent to which they are balanced by other positive environmental benefits to overall environmental values must be considered. Similarly, all three new design alternatives must be evaluated under the framework of applicable Federal law (Section 4(f)) which requires the Project to minimize overall impacts of the crossing on parklands and historic resources to the maximum extent possible.

Traffic Operations And Safety. The potential environmental and aesthetic improvements achievable under the three new design alternatives must not come at the expense of the acceptable levels of traffic operational efficiency and safety achieved by Scheme Z. The three new design alternatives must be evaluated for their ability to fulfill the transportation objectives of the Project and for their conformance to accepted highway design standards. This evaluation should include the human factors associated with extensive travel in a tunnel featuring multiple decision points as well as rapid profile and curvature changes. The three new design alternatives also address an identified traffic deficiency of Scheme Z regarding the lack of access to I-93 northbound from the northern downtown area. Efficiency of the regional highway system is improved by providing direct access in the new alternatives, resulting in a decrease of traffic volume on the local street network. The new alternatives also add a major high occupancy vehicle facility to I-93 southbound, encouraging the efficient use of the regional highway system. These improvements, which are consistent with the overall traffic and related air quality goals of the Project, must be evaluated for their consistency with open space goals and parkland protection requirements.

Cost. The cost of the Charles River crossing is not a factor in identifying an environmentally-preferable alternative; nonetheless, fiscal responsibility must be considered in choosing among alternatives if their environmental impacts, as analyzed and documented in the environmental review process, prove to be substantially equivalent.

- **Approach Of This DSEIS/R**

Inevitably, analysis of the Charles River crossing alternatives in light of the major environmental and transportation policy issues described above will identify competing concerns which need to be weighed against one another. This DSEIS/R seeks to present such analysis in an objective way, without assuming a preferred alternative. While recognizing that Scheme Z satisfies existing regulatory standards and the essential Project need, this DSEIS/R attempts to explore fully and fairly whether and how a reduction in the environmental and aesthetic impacts of the Charles River crossing may be achieved while continuing to meet Project regulatory and operational goals in the Area North of Causeway Street.

- **Summary Description Of Scheme Z And The Three New Design Alternatives**

Scheme Z. Scheme Z features three bridge structures: two cable-stayed bridges with towers on both sides of the Charles River, and a double-deck bridge differing in type and profile from the main bridge. There are no tunnels or ventilation buildings. The two cable-stayed bridges, each with five lanes in one direction, accommodate the I-93 mainline, while the double-deck bridge (three lanes over three) accommodates traffic movements to and from Leverett Circle/Storrow Drive, for a total of 16 lanes over the river. Viaduct structures in East Cambridge provide connections to Storrow Drive and Charlestown. Some traffic movements (I-93 northbound to Storrow Drive, and Storrow Drive to I-93 southbound) require motorists to cross the river twice. The dominant features of this design are the large bridge structures which have inconsistent profiles and six nested loop ramps in East Cambridge.

Alternative 8.1D Mod 5. Alternative 8.1D Mod 5 includes a 10-lane cable-stayed mainline bridge with a single twin-leg tower on the north side of the river, a single loop ramp in East Cambridge, a three-lane northbound tunnel under the river, and land tunnels under East Cambridge, the North Station commuter railroad tracks, and the Registry of Motor Vehicles building. Over 10,000 linear feet (lf) of structure are in tunnel, the greatest length of tunnel structure of any of the three alternatives. A ventilation building is required on the south side of the river to service the tunnel. I-93 mainline traffic crosses the Charles on a single bridge with four lanes in each direction. An additional two lanes on the western side of the mainline bridge carry I-93/Route 1 southbound traffic to Leverett Circle/Storrow Drive, for a total of 10 lanes over the river. The North Station area tunnel portion accommodates traffic between I-93 and Storrow Drive, and the tunnel under the Charles River accommodates northbound traffic between Storrow Drive, I-93 and Route 1 (Tobin Bridge).

Reduced River-Tunnel Alternative. This design incorporates revisions of 8.1D Mod 5 which address FHWA concerns about Leverett Circle traffic operations and the operational and safety issues posed by travel in the proposed river tunnel. The I-93 to Route 1 (Tobin Bridge) movement is taken out of tunnel and placed on a viaduct structure by adding two lanes to the mainline bridge. This reduces the amount of tunnel travel by approximately 4,000 lf to 6,150 lf. The 12-lane mainline bridge (four lanes each north and south, two lanes on the western side of the mainline carrying I-93/Route 1 southbound traffic to Leverett Circle/Storrow Drive, and two lanes on the eastern side carrying traffic from downtown and the Sumner Tunnel to I-93 northbound) is supported by two towers, one on each side of the river. There are two loop ramps in East Cambridge, and a two-lane northbound tunnel under the Charles River (carrying traffic from I-93 northbound to Storrow Drive), with a ventilation building on the north side of the river. The land tunnels under the North Station commuter railroad tracks (carrying traffic from Storrow Drive to I-93 southbound) require one ventilation building on the south side of the river.

Non-River-Tunnel Alternative. The Non-River-Tunnel Alternative takes Storrow Drive-to-Tobin Bridge traffic out of tunnel and places it on viaduct, resulting in an additional 3,000 lf reduction in the amount of tunnel. There are three loop ramps, reducing to two loop ramps in East Cambridge, and a total of 14

lanes of traffic crossing the Charles River. The mainline bridge is a 10-lane cable-stayed structure with a tower on either side of the river. The mainline bridge features four lanes in each direction and an additional two lanes on its eastern side which carries downtown Boston and Sumner Tunnel traffic to I-93 northbound. A second bridge, which has the same profile as the mainline structure, carries an additional four lanes (two in each direction) to/from Storrow Drive/Leverett Circle. A total of 3,300 lf of highway remain in tunnel in the North Station area.

- **Summary Of Environmental Impacts**

Traffic And Transportation. In general, the three new design alternatives improve traffic and level of service (LOS), compared to Scheme Z. All three have the positive effect of shifting daily traffic volumes to the expressway system and away from local and arterial streets. There are two reasons for this:

- elimination of the need for double crossings of the Charles River, which increases the capacity of I-93 and allows it to be used more efficiently
- inclusion of a new northbound on-ramp in the upper downtown area (at New Sudbury Street), making I-93 more accessible

All three new alternatives also further reduce traffic volume and improve operations in City Square due to the relocation of the Scheme Z City Square off-ramp to an area north of the Gilmore Bridge.

Traffic conditions on the I-93 mainline are similar overall for Scheme Z and the three new alternatives. Variations occur in different parts of the mainline and at different times of day. The number of intersections operating at LOS F in the PM peak hour are highest with Scheme Z (eight), and lowest with the Non River-Tunnel Alternative (four). In the AM peak hour, nine intersections operate at LOS F with Scheme Z and Alternative 8.1D Mod 5, and eight intersections operate at LOS F with the Reduced River-Tunnel and the Non-River-Tunnel alternatives.

Alternative 8.1D Mod 5 has the highest accident rate, due to the curvature of tunnel in the eastbound direction, and the long total length of tunnel section. Scheme Z has the lowest accident rate, and the Non-River-Tunnel Alternative has the second lowest accident rate, primarily because the length of tunnel section is lower than with Alternative 8.1D Mod 5 or the Reduced-River-Tunnel Alternative.

The new design alternatives include an HOV lane on the I-93 southbound mainline which is not included in Scheme Z. Scheme Z has an HOV facility on the Nashua Street off-ramp only. None of the alternatives includes a dedicated northbound HOV lane due to the lack of substantial benefits accruing from a northbound facility.

No permanent impacts on commuter rail are anticipated. Some impacts on light rail and rail rapid transit are anticipated, but are being coordinated with the MBTA. The new design alternatives do not preclude the development of a future rail link between North and South Stations.

Existing hazardous cargo routes are not affected by any of the design alternatives. Hazardous cargo route connections to the tunnels being constructed as part of the CANA project are possible with Scheme Z and the Non-River-Tunnel Alternative, but not with Alternative 8.1D Mod 5 or the Reduced-River-Tunnel Alternative. Trucks carrying hazardous cargo will be prohibited from all tunnel segments of the Central Artery.

Land Use Including Open Space. None of the alternatives results in long-term land use pattern changes; however, all affect development opportunities of land on both sides of the river, all result in takings of land and buildings, and all affect existing and planned open space.

The major land use impact is on existing and proposed parkland and open space. All alternatives allow expansion of parkland. There is some encroachment on the area by Scheme Z structures. Parkland impacts are discussed in the Section 4(f) Evaluation summary.

North Point Area: In the North Point, all new alternatives have similar impacts on area development and recreational use of the river. Alternative 8.1D Mod 5 is marginally better than the other alternatives. All new designs represent a major improvement over Scheme Z.

North Bank Transportation Corridor: This corridor, which includes the MBTA commuter railroad tracks and bascule bridge and the existing I-93 bridge, is very much constrained by Scheme Z. Its three bridges carrying 16 lanes cover 400 lf of shoreline. Alternative 8.1D Mod 5, which carries 10 lanes, is 170 feet wide, and covers 220 lf of riverbank, opens this area to the greatest extent of the three new design alternatives. The Reduced River-Tunnel Alternative carries 12 lanes, is 230 feet wide, and covers 300 lf of riverbank. The Non-River-Tunnel Alternative consists of two bridges carrying 14 lanes and covering two sections of river: 80 lf of riverbank under the Storrow Drive connector bridge, followed by a 125-lf open space, followed by 220 lf of shadow. All alternatives are a major improvement over Scheme Z.

South Bank Transportation Corridor: This area between Paul Revere Landing Park South and the railroad crossing is, primarily, part of the riverfront path system. In Scheme Z, mainline bridges extend into this area, and a double-deck three-lane Storrow Drive connector bridge passes directly over it. In Alternative 8.1D Mod 5 and the Reduced-River-Tunnel Alternative, views are more open, although the underside of the bridge and its towers are the primary view. The Non-River-Tunnel Alternative offers superior bridge aesthetics and a wider gap between bridges compared to Scheme Z.

City Square Park: City Square Park is being constructed on land made available by the CANA project. All new alternatives have a positive effect on the park, compared to Scheme Z, because they remove the City Square off-ramp to a location north of Gilmore Bridge, reducing traffic in City Square and providing a safer setting and better access to the park.

Property Takings. All three new design alternatives require more permanent takings than Scheme Z and have greater right-of-way impacts. All involve acquisition of the Spaulding Rehabilitation Hospital, and the Boston Thermal Energy Corporation's Minot Station steam generating plant. Scheme Z does not affect Spaulding Hospital or the Minot Station plant. All three new design alternatives also require the reconfiguration of a Bunker Hill Community College baseball field and jogging track.

Economic Impacts. It is anticipated that macroeconomic fluctuations in the business cycle have a greater impact on this area than either Scheme Z or the any of the three new design alternatives will have. However, all the alternatives will have more positive aesthetic impacts, compared to Scheme Z, on the proposed North Point development, making it more attractive for development.

Joint Development. Four parcels of land have potential for joint development: the Massachusetts General Hospital Nashua Street parcel; the air rights garage parcel above the MBTA railroad tracks; the Lomasney Way parcel; and the Rutherford Avenue parcel. In general, the project allows for joint development, with the exception of the Lomasney Way parcel. Development of this parcel is possible

only with the Non-River-Tunnel Alternative, and in this case only on a portion of the parcel. The Non-River-Tunnel Alternative decreases the size of the air rights garage by 49 percent.

Air Quality. Overall, the three new alternatives represent a slight benefit to air quality when compared to Scheme Z, and are not substantially different from each other. The regional areawide (mesoscale) analysis shows decreases in emissions of Carbon Monoxide (CO), Nitrogen Oxides (NO_x), and Volatile Organic Compounds (VOC) for each of the new design alternatives, compared to Scheme Z.

The microscale analysis indicates that there will be no violations of ambient air quality standards for the years 2001 and 2010 for any of the alternatives. CO concentrations in 2010 are estimated to improve at 12 to 14 locations with any of the alternatives, compared to Scheme Z, largely because of better traffic operations on local and arterial streets with the alternatives. The Reduced-River-Tunnel and the Non-River-Tunnel have beneficial impacts compared to Scheme Z. Alternative 8.1D Mod 5 has overall levels very similar to Scheme Z, with improvements at some intersections and deterioration at others.

All three alternatives have tunnel elements and ventilation buildings. No violations of any air quality standards are predicted as a result of any proposed ventilation building. Differences in air quality benefits are small among the three design alternatives, though 8.1D Mod 5 has the least beneficial effects in terms of short-term impacts, and the Reduced River-Tunnel Alternative yields the highest annual impacts.

Noise and Vibration. Traffic noise impacts of each of the three new alternatives were assessed at each of 23 receptor sites. For Scheme Z, design year 2010 noise levels are higher than existing levels at 21 out of 23 sites. Since the highest increase is 12 dBA, a moderate impact is expected. For 8.1D Mod 5 and The Non-River-Tunnel Alternative, design year 2010 noise levels are higher than existing levels at 20 out of 23 sites, and for the Reduced River-Tunnel Alternative, design year 2010 noise levels are higher than existing levels for 21 sites. The highest increase for all three new design alternatives is 10 dBA; thus, no substantial impacts are expected.

Noise levels approach or exceed FHWA outdoor Noise Abatement Criteria (NAC) at 22 of the 23 sites. Existing noise levels currently approach or exceed the FHWA criteria at 19 out of the 23 sites. Noise barriers are recommended at two sites where increases in noise levels are predicted: Bunker Hill Community College and the Gilmore Bridge near the proposed North Point housing. Noise mitigation will be studied further as part of the design process for the preferred alternative.

Noise from ventilation buildings is greatest for 8.1D Mod 5 because it is built above grade. Ventilation buildings for the Reduced River-Tunnel Alternative, which requires two buildings, and the Non-River-Tunnel Alternative are constructed below grade, with exhaust and air intake stacks above grade. For these two alternatives, ventilation building noise levels satisfy DEP criteria. For Alternative 8.1D Mod 5, sound attenuation measures will be added, if necessary, to satisfy City of Boston property line noise criteria.

Future traffic vibrations are not predicted to reach levels high enough to cause damage to historic or nonhistoric structures, or annoyance to people inside buildings.

Wetlands. Scheme Z and the three new design alternatives have minimal long-term (permanent) impacts to Federal and State aquatic resources in the Charles River due to limited fill for bridge piers. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative have greater short-term (temporary) impacts on Federal and State aquatic resources due to tunnel construction which will occur over a 2- to 3-year period. All three new design alternatives will result in the fill of over 1.1 acres of aquatic resources in the Millers River for access ramps. The Millers River, however, is a substantially degraded

resource area, which serves minimal wetlands functions. All activities in the Charles and Millers Rivers will have an insignificant impact to the principal value functions of Federal jurisdictional aquatic resources, and the performance standards of the Massachusetts Wetlands Protection Act will be met.

Water Quality. Scheme Z and the three new alternatives will result in minor temporary increases of turbidity due to the construction of bridge piers. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative have the potential to result in greater temporary impacts due to river tunnel construction, however, this impact will be controlled by a master pile/sheet pile (vertical excavation support) arrangement.

Navigation. No long-term impacts to navigation in the Charles River are expected from any of the three new alternatives. Unavoidable short-term impacts will require close coordination with the affected community and agencies having jurisdiction over navigation.

Fisheries. There are no long-term adverse impacts to fish habitats under any alternative.

Water Quality. Stormwater flows for Scheme Z do not cause a significant degradation of water quality, and tunnel washdown water is discharged to sanitary sewers for treatment. All new alternatives generate less stormwater than Scheme Z since more roadway is in tunnel.

Other Aquatic Resources. The Project has minimal long-term impacts on floodplains or wildlife. All alternatives are consistent with the Massachusetts Coastal Zone Management program.

Threatened And Endangered Species. No known Federal-listed threatened or endangered species are known to use the Area North Of Causeway Street.

Historic And Archaeological Preservation. Generally, none of the three new design alternatives has adverse long-term impacts that significantly impair the integrity and attributes of the historic resources in the affected area. The new alternatives require the underpinning of the Registry building. If new archaeological resources are identified in the I-93 corridor north of the Gilmore Bridge, these may be mitigated by revisions to locations of structural supports for the new adjacent collector/distributor viaduct.

Hazardous Waste Sites. To date, no hazardous waste sites or areas of extensive soil or groundwater contamination have been identified in the Area North of Causeway Street.

Visual Impacts.

Scheme Z: Scheme Z creates a noticeable impact on the visual environment of motorists, pedestrians, and adjacent buildings. Three bridges, including 16 lanes, cross the Charles River, lower and wider than the existing bridge, and a vast multilevel ramp system imposes on North Point and the north bank of the Charles River. Views from the bridge are possible, but are often obscured by viaducts and piers. Scheme Z passes 55 feet above the Charles River and is supported by 11 piers in the water. The piers visually dominate the river and create a 270-foot-long corridor of shadow, including 65 feet of gaps. Parkland proposed along the river is narrowed and partly in shadow, due to the loop ramps.

Alternative 8.1D Mod 5: The visual impact of 8.1D Mod 5 differs substantially from Scheme Z because of the extensive use of tunnels instead of viaducts. The view of this alternative from surroundings is improved, compared to existing conditions and to Scheme Z. Motorists on the viaducts have views in all directions, but, in the tunnels, visual impacts are negative, including tight radii, difficult merges, and long durations in tunnel, due to geometrically complex tunnel alignments. In comparison with Scheme Z, highway impacts on the proposed parkland are modest, and the coordinated design of visible highway

elements enhances the water environment. An above-ground ventilation building with stacks will occupy land on the south bank, which has optimum riverfront views.

The Reduced River-Tunnel Alternative: The visual impacts of the Reduced River-Tunnel Alternative are improved compared with Scheme Z. There are 12 lanes of traffic on viaducts crossing the Charles and approximately 6,300 lf of tunnel. Design elements are compatible with surrounding areas. Bridge piers are placed on either bank, and shadows from the elevated viaduct are separated by daylight into four sections, improving the visual experience of the water environment below. On each side of the river, there is one below ground ventilation building, each with visible stacks. Tunnel egress stair headhouses are also required.

The Non-River-Tunnel Alternative: Visual impacts of the bridges in this alternative are lessened by the separation of the two structures and the use of a single-deck bridge, which marks an improvement over Scheme Z. This reduces shadows on the parkland, and visually separates the cable-stayed bridge from the viaduct, providing a less cluttered view. The Non-River-Tunnel Alternative has 14 lanes of traffic on viaducts, including one 10-lane long-span and one four-lane medium-span bridge, and 2,850 lf of land-based tunnels on the south bank of the Charles River. Ramps are lower, simpler in design, more coordinated with other elements, and visual impacts on the water environment are minor, when compared to Scheme Z. A below-ground ventilation building with visible stacks is located on the south side of the river.

Energy. The differences in energy requirements of Scheme Z and the three new alternatives are negligible, with less than a 2.0 percent difference among them.

Construction Staging And Sequencing. Construction period impacts for any of the four designs will cause disruption in the Project area. The goal of the Project is to stage construction with traffic control plans which maintain existing traffic conditions with as little disruption as possible, regardless of which alternative is selected as the preferred alternative. All bridge construction, and to a greater extent the alternatives which include tunnels in the Charles River, require turbidity controls and temporarily interfere with navigation. Scheme Z, the Reduced River-Tunnel Alternative, and the Non-River-Tunnel Alternative result in similar construction durations (approximately 8 to 8.5 years). Alternative 8.1D Mod 5 will take a longer time to construct (approximately 13 years), largely due to complex staging required to meet maintenance of traffic goals.

Materials Disposal. The total volume of dredged and excavated material ranges from a low of 154,000 cubic yards for Scheme Z to a high of 1,085,000 cubic yards for 8.1D Mod 5. Excavated materials will be processed into Project backfill or landfill cover or shaping material, or for distribution to municipal landfills as cover. Excavated materials and dredged materials will be disposed of in accordance with applicable regulations.

Short-Term Versus Long-Term Impacts. Construction of any of the four designs includes measures to mitigate potential short- and long-term adverse impacts. With the above general commitments, the short-term construction period impacts are minimized while enhancing the long-term productivity of the environment. Moreover, the cumulative impacts of the Project are considered beneficial to the regional environment, and far outweigh local adverse impacts.

Areas of Controversy. Areas of controversy include the following: whether the loop ramps in East Cambridge and the proposed bridge structures and tunnels in the new design alternatives represent an appropriate and achievable balance between transportation objectives and aesthetic and environmental

interests; the inclusion of the eastbound tunnel from Storrow Drive under Leverett Circle; and mitigation for Bunker Hill Community College athletic facilities affected by the I-93-to-Rutherford Avenue off-ramp.

Major Unresolved Issues. Major unresolved issues are addressed in the discussion of major policy issues contained in the Introduction to this summary. Selection of the preferred alternative from the four designs will be resolved in the FSEIS/R. The National Park Service requested direct access to the Charlestown Navy Yard, an issue which is still under discussion. A specific mitigation program for the Boston Thermal Energy Corporation's Minot Station steam plant, which will be displaced by any of the new alternatives, is still under discussion.

- **Major Actions Proposed By Other Governmental Agencies In The Project Area**

The MBTA plans to upgrade commuter rail service at North Station; construct new Orange Line/Green Line station below grade; placing the Green Line underground. The MBTA North Station garage includes foundation supports for future air rights development. The MBTA also plans to relocate the Green Line Lechmere station and to reconstruct the Science Park station.

The Metropolitan District Commission (MDC) seeks to develop continuous open space along the north and south banks of the Charles River between the Esplanade and Boston Harbor, including a new park between Nashua Street and the Charles River; a new park on the Cambridge side of the river; and extensions of pedestrian and bicycle paths.

The Cambridge Community Development Department has reviewed plans for the North Point area which include redevelopment for mixed residential/commercial use.

The Massachusetts Executive Office of Transportation and Construction and the Federal Transit Administration are both investigating the feasibility of constructing a continuous rail link through central Boston, including through the Area North of Causeway Street Project subarea. The new underground rail link would provide through service that now terminates at North and South Stations, respectively.

- **Other Federal Actions Required For Implementation Of Proposed Action**

Section 10 Permit, for construction and dredging in navigable waters, U.S. Army Corps of Engineers.

Section 103 Permit (Marine Protection, Research, and Sanctuaries Act) for ocean disposal of dredged material, U.S. Army Corps of Engineers.

Section 106 (National Historic Preservation Act of 1966) review.

Section 404 Permit for discharge of dredged or fill material in waters of the U.S., U.S. Army Corps of Engineers.

Section 401 Water Quality Certification (U.S. Clean Water Act). Administered by the Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control.

Federal Aviation Regulations, Parts 77, 151, 152. Federal Aviation Administration.

U.S. Coast Guard permits for new bridges over navigable waters.

U.S. Coast Guard permits for alteration of existing bridges.

Summary Of Section 4(f) Evaluation

Section 4(f) of the Department of Transportation Act of 1966 protects significant public parklands and historic resources by requiring transportation projects to provide design and mitigation that will compensate for impacts on them. Section 4(f) properties include the following:

- **Parklands**

Leverett Circle/Storrow Drive (Charles River Esplanade): Scheme Z and all new alternatives reconfigure Leverett Circle, with some areas of highway landscaping converted to pavement, and other areas converted from pavement to landscaping. All show a net decrease in landscaping, though some landscaped land is added.

Charles River Basin Extension Recreation Area: This water recreation area between the old dam and the MBTA bridge is adversely affected by views and noise in Scheme Z. The new alternatives substantially reduce visual impacts by reducing the number and height of loop ramps on the north bank of the river, and reduce noise impacts through greater setbacks. The river tunnel alternatives disrupt this area during construction.

Nashua Street/Spaulding Walkway: This area is planned for informal passive uses. In Scheme Z, it is dominated by views and noise of six densely nested loop ramps, rising 105 feet in height, across the river. The double-deck Storrow connector bridge and the mainline bridges beyond also obstruct views. All new alternatives substantially improve the quality of this area, compared to Scheme Z.

Parkland At The Former GSA Site: The MDC proposes a docking facilities for small boats (canoes and paddleboats) at this location. All new alternatives reduce visual impacts on this park site substantially over Scheme Z.

Paul Revere Landing Park North: This area will be expanded upstream as a mitigation measure of the Project, under any design selected. The new alternatives will have visual and noise impacts on this park, envisioned as a major passive use area oriented to the river and the locks. All new alternatives, by moving the City Square off-ramp, allow further expansion of this park, compared to Scheme Z,

Charles River Dam Walkway: All alternatives, including Scheme Z, improve the setting of the Charles River dam walkway by removing the existing I-93 bridge and replacing it with a new bridge farther upstream.

Paul Revere Landing Park South: In all three new design alternatives, the planned functions and uses of the MDC master plan (i.e., an entry area for the riverfront park system, pedestrian connections, and passive uses oriented to the river and the locks) can be implemented successfully. The new alternatives offer vastly improved bridge aesthetics over Scheme Z, which would benefit future park users.

Bunker Hill Community College Athletic Facilities: Relocation of a ballfield and a jogging path are required to allow construction of the northbound off-ramp to Rutherford Avenue. Adequate land is available to reconfigure these facilities.

- **Historic Resources**

Charles River Basin District: Reconfiguration of Leverett Circle minimally changes the definition of this historic district, but does not affect contributing features of the district.

Granite Seawalls In The Lower Basin Of The Charles River: Scheme Z and all new alternatives require reconstruction of portions of seawall. In all instances, the seawalls would be dismantled and replaced in their existing condition.

Tower A: Scheme Z dramatically alters the setting of the railroad building. Alternative 8.1D Mod 5 substantially reduces these visual impacts. The Reduced River-Tunnel and the Non-River-Tunnel Alternative avoid any permanent use.

100 Nashua Street (Registry Of Motor Vehicles): Scheme Z does not affect this resource. All new alternatives have a southbound tunnel which passes under the building, requiring underpinning before construction.

North End District: Scheme Z offers long-term benefits by removing the existing Central Artery viaduct. In all new alternatives, the outer slurry wall of the Artery northbound tunnel passes across and under the corner of Stillman Street and Stillman Place, and temporarily uses a small area of historic paving materials in Stillman Place. Nevertheless, the new alternatives have a long-term positive effect on the district by reducing traffic impacts over Scheme Z.

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1. Purpose And Need For Action

Chapter 1

PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

After more than two years of study and refinement of designs, the Massachusetts Highway Department (MHD) submits this Charles River Crossing Draft Supplemental Environmental Impact Statement/Report (DSEIS/R) for the Area North of Causeway Street subarea of the Central Artery/Tunnel Project (the Project) in Boston and Cambridge (see Figure 1.1).

This DSEIS/R describes three new design alternatives for the Charles River crossing and compares the potential environmental impacts of each of the design alternatives to the Proposed Action (Scheme Z) in the Final Supplemental Environmental Impact Statement/Report (FSEIS/R) approved in 1991 and to each other. The three new alternatives include Alternative 8.1D Modified 5 (Mod 5) as described in the Notice of Project Change (NPC) submitted to the Executive Office of Environmental Affairs (EOEA) and the United States Department of Transportation Federal Highway Administration (FHWA) on September 30, 1992, and two subsequent revisions to Alternative 8.1D Mod 5. These two additional alternatives consist of a Reduced River-Tunnel Alternative and a Non-River-Tunnel Alternative which were both developed in direct response to the concerns voiced by FHWA (and regulatory agencies including the United States Army Corps of Engineers, USACE) regarding Alternative 8.1D Mod 5. The scoping requirements issued by FHWA and EOEA mandated the evaluation of the environmental impacts of the Reduced River-Tunnel Alternative and the Non-River-Tunnel Alternative in addition to the evaluation of the environmental impacts of the design presented in the NPC (see Figure 1.2).

The Draft Section 4(f) Evaluation is published at the end of the DSEIS/R.

1.2 PURPOSE AND NEED FOR ACTION

The Project will depress and widen the Central Artery (I-93) through downtown Boston to Charlestown, and will construct (as an extension of I-90) a new Seaport Access Highway through South Boston connecting to a new tunnel under Boston Harbor to Logan Airport in East Boston. This regional transportation improvement was proposed for environmental analysis in 1983 and was formally reviewed under the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA) from 1983 through 1985. The FEIS/R for the Project was approved by FHWA and by EOEA in January 1985. A Final Supplemental Environmental Impact Statement/Report (FSEIS/R) detailing a number of design refinements and resolving a series of issues left open in 1985 was published in November 1990. The Secretary of EOEA issued a Final Certificate on January 2, 1991, and on May 10, 1991, FHWA issued its Record of Decision.

The purpose and need for action for the entire Central Artery/Tunnel Project as presented in the 1985 FEIS/R and the 1991 FSEIS/R are demonstrably still valid today. The major purposes are as follows:

- To increase capacity, reduce congestion, and improve the flow of traffic along the Central Artery from the Charles River to the interchange with the Massachusetts Turnpike (I-93/I-90 interchange); to reduce traffic congestion and improve traffic flow on streets and highways in the Project area, including those that connect to the Central Artery; and to improve system safety.

- To complete I-90 in Massachusetts, and to double cross-harbor capacity and improve access to Logan Airport.
- To increase accessibility to the South Boston seaport area.

The remainder of the discussion in the 1991 FSEIS/R regarding purpose and need for the entire Project is incorporated by reference and is not repeated here.

1.3 PURPOSE AND NEED FOR ACTION (AREA NORTH OF CAUSEWAY STREET)

The Charles River crossing is needed to link regional highway facilities on the south side of the river (the Central Artery, Storrow Drive and the Sumner/Callahan Tunnels) to the essential regional connections on the north side of the river (I-93 north and the Tobin Bridge/Route 1) and to complete all necessary local connections to these facilities.

The subarea of the Project under review in this DSEIS/R is the Area North of Causeway Street, as identified in the 1991 FSEIS/R. The northern Project subarea limit is extended northerly to Sullivan Square (at the Charlestown/Somerville border) to include the proposed I-93 southbound high-occupancy vehicle (HOV) lane. The southerly limit of the Project subarea, Causeway Street, is the same as identified in the FSEIS/R and the NPC. While a proposed I-93 on-ramp at New Sudbury Street is located in the Central Area (the adjacent Project subarea to the south), its effects are described in this DSEIS/R.

1.3.1(a) Major Policy Issues Affecting The Charles River Crossing

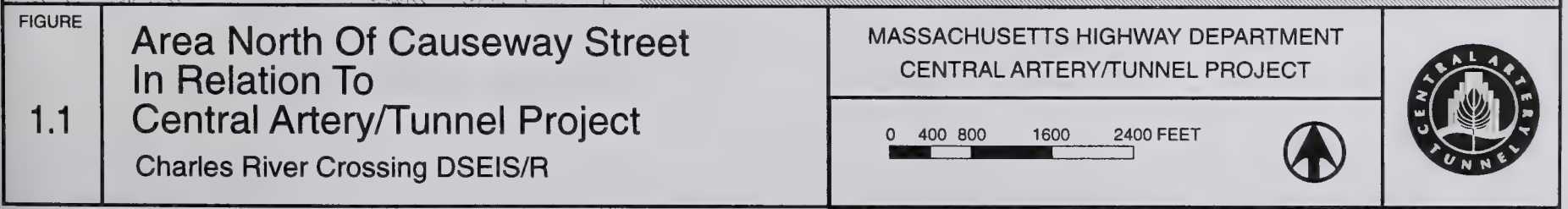
The following discussion briefly summarizes the major policy issues articulated throughout this two-year reevaluation of the Charles River crossing.

Scheme Z remains the Proposed Action for the Project in the Area North of Causeway Street unless and until a new design for the Charles River crossing is approved. The three new design alternatives under consideration are intended to further reduce the environmental and aesthetic impacts of Scheme Z, while maintaining its level of improvement in regional traffic service.

Scheme Z provides acceptable traffic operations for the Project. Furthermore, the Scheme Z design was approved in concept during the 1991 environmental review process by agencies having jurisdiction over parklands, historic, and wetland issues. These issues constitute key environmental impact categories for any new highway crossing of the Charles River. The overall impacts associated with Scheme Z led MHD to engage in an effort to further reduce its environmental and aesthetic impacts through a broad public participation process requested by the Secretary of the EOEA.

In attempting to reduce the impacts of the Charles River crossing, MHD has developed three new design alternatives which seek to balance a variety of key concerns, including specific regulatory mandates regarding protection of parklands, historic resources, and wetlands, as well as considerations of aesthetics, traffic capacity, and safety. These issues have guided the evaluation of the three new design alternatives and will continue to be important in the selection of a preferred alternative.

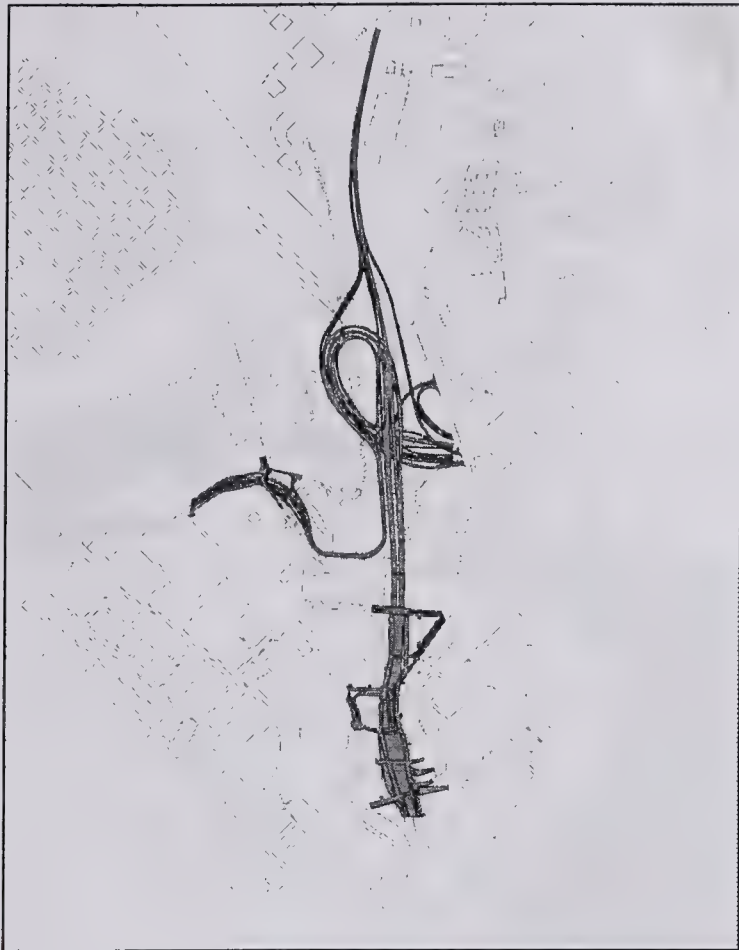
Environmental And Aesthetic Impacts. The most direct means of reducing aesthetic impacts of the Charles River crossing is to replace above-ground structures with tunnels. The three new design alternatives assessed in the DSEIS/R examine whether a viable solution, using land-based tunnels, and in two alternatives, river tunnels, can be achieved.



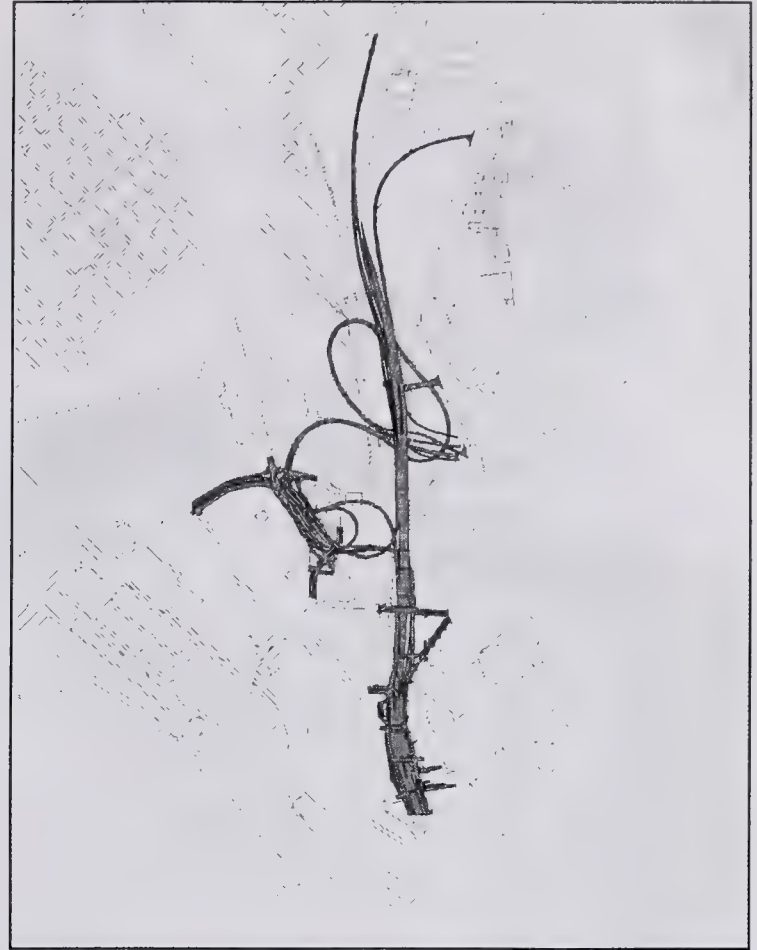
MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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Scheme Z



Alternative 8.1D Mod 5



Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

FIGURE

1.2

Scheme Z And Alternatives

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



Reduction in the mass of the Scheme Z loop ramps and relocation of the loop ramps away from the river's edge have been a primary focus of the Charles River crossing redesign effort. Each of the three new design alternatives succeeds in reducing the mass of these loop ramp structures. In addition, none of the three new design alternatives has loop ramps which are situated closer than 120 feet away from the river's edge at their nearest point. Each of the three new design alternatives also results in a reduction in the width of bridge structure.

These aesthetic and open space improvements raise a corresponding series of new issues. For example, reducing the mass of loop ramps structures leads to the inclusion of a new signalized intersection in all of the three new design alternatives. Construction of this intersection requires placement of fill in the northern portion of the Millers River. River tunnel construction employed in two of the three new design alternatives also poses aquatic impacts not present under Scheme Z or under the Non-River-Tunnel Alternative. These aquatic impacts must be reviewed under the applicable regulatory framework to determine if they can be avoided. If not, the extent to which they can be successfully mitigated and the extent to which they are balanced by other positive environmental benefits to overall environmental values must be considered. Similarly, all three new design alternatives must be evaluated under the framework of applicable Federal law (Section 4(f)) which requires the Project to minimize overall impacts of the crossing on parklands and historic resources to the maximum extent possible.

Traffic Operations And Safety. The potential environmental and aesthetic improvements achievable under the three new design alternatives must not come at the expense of the acceptable levels of traffic operational efficiency and safety achieved by Scheme Z. The three new design alternatives must be evaluated for their ability to fulfill the transportation objectives of the Project and for their conformance to accepted highway design standards. This evaluation should include the human factors associated with extensive travel in a tunnel featuring multiple decision points as well as rapid profile and curvature changes. The three new design alternatives also address an identified traffic deficiency of Scheme Z regarding the lack of access to I-93 northbound from the northern downtown area. Efficiency of the regional highway system is improved by providing direct access in the new alternatives, resulting in a decrease of traffic volume on the local street network. The new alternatives also add a major high occupancy vehicle facility to I-93 southbound, encouraging the efficient use of the regional highway system. These improvements, which are consistent with the overall traffic and related air quality goals of the Project, must be evaluated for their consistency with open space goals and parkland protection requirements.

Cost. The cost of the Charles River crossing is not a factor in identifying an environmentally-preferable alternative; nonetheless, fiscal responsibility must be considered in choosing among alternatives if their environmental impacts, as analyzed and documented in the environmental review process, prove to be substantially equivalent.

1.3.1(b) Approach Of This DSEIS/R

Inevitably, analysis of the Charles River crossing alternatives in light of the major environmental and transportation policy issues described above will identify competing concerns which need to be weighed against one another. This DSEIS/R seeks to present such analysis in an objective way, without assuming a preferred alternative. While recognizing that Scheme Z satisfies existing regulatory standards and the essential Project need, this DSEIS/R attempts to explore fully and fairly whether and how a reduction in the environmental and aesthetic impacts of the Charles River crossing may be achieved while continuing to meet Project regulatory and operational goals in the Area North of Causeway Street.

1.4 BACKGROUND

The following subsections (1.4.1 to 1.4.6) briefly describe the evolution of the design alternatives presented in this DSEIS/R. They summarize detailed information readily available in the 1991 FSEIS/R and the 1992 NPC. This detailed treatment is not repeated in its entirety in this document.

1.4.1 1986 FEIS/R

In 1983, an environmental analysis was initiated for the entire Central Artery/Tunnel Project in compliance with NEPA and MEPA. The Final Environmental Impact Statement/Report (FEIS/R) identified a Preferred Alternative known as "Alternative 5A Modified" which was approved by FHWA and EOEa in January 1986. The FEIS/R, however, also identified 14 unresolved issues requiring further study; among these unresolved issues was the final design of the Charles River crossing.

1.4.2 1991 FSEIS/R

Design studies undertaken by MHD during the preparation of the 1991 FSEIS/R included further planning, engineering, and environmental reviews of the Preferred Alternative. The 1986 FEIS/R Preferred Alternative was refined substantially to resolve remaining design and mitigation issues. The results of the impact analysis of the refined design are presented in the 1991 FSEIS/R.

During preparation of the FSEIS/R, several design options based on viaduct, river tunnel, and combinations of both were evaluated in the Area North of Causeway Street subarea. MHD evaluated 32 different design options between 1987 and 1990. Four "families" of design options were evaluated in the 1991 FSEIS/R (Part IIB 4): Alternatives 5A Modified, T Modified, S Modified, and Z Modified. The FSEIS/R identified the Proposed Action in this subarea as an all-viaduct option, referred to as Scheme Z.

This Charles River crossing DSEIS/R responds to two developments resulting from the 1991 FSEIS/R:

- The Secretary of EOEa, in the final Certificate for the FSEIR, dated January 2, 1991, required MHD to: "continue to review modifications and options to Scheme Z (the Proposed Action) which might reduce the environmental and aesthetic impacts of the Charles River crossing, and to embark on a process to better inform the public about the crossing."
- The FHWA, in its Record of Decision for the FSEIS, dated May 10, 1991, agreed to remain open throughout the Project development process to take advantage of new information that may reduce environmental impacts. FHWA supported the design review process required by the Secretary of EOEa which provided further insight on the final design of aesthetic bridge structures, as well as improvements in the related interchange and regional park development opportunities.

1.4.3 1991 BDRC Process

In February 1991, the Executive Office of Transportation and Construction (EOTC) established a bridge Design Review Committee (BDRC) in compliance with the directive contained in the MEPA Certificate. The BDRC assessed a broad spectrum of design in the Area North of Causeway Street with support from EOTC, MHD's management consultant, and independent experts.

The principal concerns of the BDRC, as described in the NPC, were:

- Restore the Traverse Street on-ramp or an equivalent move to reduce additional traffic on local streets and negative noise and air quality impacts.
- Reduce visual impacts of bridge and ramp height/massing to improve visual design.
- Ensure positive development/design of parklands along the Charles River Basin, which is adversely affected by Scheme Z.
- Investigate alternative schemes, including partial and/or full tunnel alternatives, to find a superior solution to the river crossing.
- Reduce negative impacts of bridge piers and overhead structures on aquatic resources and navigation in the Charles River and the Millers River and on open space along their banks.
- Incorporate/improve non-automobile transportation, including pedestrian and bicycle routes, ferry service at Lovejoy Wharf, and bus and HOV routes.
- Provide pedestrian and bicycle routes along both banks of the Charles River and connection both to and across the river from Charlestown, Cambridge, and Boston.
- Maintain/review all connection to the regional roadway system. Give special consideration to the role played by Storrow Drive in the regional system and maintain its character as part of the Esplanade.
- Minimize construction impacts; maintain road and transit connections during construction.

The BDRC process also sought to avoid undue delay of the Project.

1.4.4 BDRC Action

The BDRC considered more than 20 alternative designs for the Charles River crossing. Options were narrowed to three Committee Improvement Packages (CIP):

- CIP 3: containing three loop ramps in Cambridge, and a double-deck bridge over the Charles River with Storrow Drive connections on the top level
- CIP 5: containing two loop ramps in Cambridge and a four-lane river crossing tunnel carrying Storrow Drive connections
- CIP 8: a hybrid option of CIPs 3 and 5, with the northbound Storrow Drive connection in river tunnel, and the southbound connection on the bridge as part of the mainline crossing

The three new design alternatives presented in this DSEIS/R have common key features which address the BDRC's desire "to reduce the environmental and aesthetic impacts of the crossing." The land-based tunnels (common to all three new alternatives) connecting Storrow Drive with the Central Artery are instrumental in achieving these objectives. CIPs 3, 5, and 8 were based on concepts designed: (1) to avoid parallel bridges with inconsistent profiles; (2) to reduce the overall bridge width; and (3) to simplify the complexity of the 1991 Proposed Action, reducing the number of supporting columns in the Charles River and the visual clutter of columns on land. In June 1991, the BDRC indicated a slight preference for a variation of CIP 8 (8.1) over a variation of CIP 5 (5.3).

1.4.5 1992 Notice of Project Change

MHD continued design development of CIP 8.1 in consultation with the BDRC. An NPC was prepared and filed with EOEA on September 30, 1992, describing the refined design Alternative 8.1D Mod 5 and its potential impacts. In addition, a Notice of Intent to file an SEIS with the Environmental Protection Agency (EPA) was published by FHWA in the Federal Register on November 15, 1992.

Alternative 8.1D Mod 5 was presented to abutters and special interest groups at many meetings. It also was presented to affected residents and others at four public meetings: in Charlestown (October 29, 1992), in East Cambridge (November 5, 1992), at Spaulding Rehabilitation Hospital (November 10, 1992), and at the Project office in South Station (November 12, 1992).

1.4.6 Scoping For The DSEIS/R

During the NPC review and comment period, public scoping sessions for this DSEIS/R were held by the EOE/MEPA Unit on November 4, 1992, and FHWA on December 9, 1992.

Among the agency commenters, the U.S. Army Corps of Engineers (USACE) indicated that there may be design options other than 8.1D Mod 5 which have fewer temporary and permanent impacts to water and wetland resource areas. USACE administers the Section 404 program regulating dredging and filling work in the waters of the U.S. USACE may issue a permit for this work only if the selected design represents the "least environmentally damaging practicable alternative." The draft FHWA Scope of Work suggested the study of a refinement which did not include a river tunnel.

FHWA indicated it had concerns about the operational safety of the river-tunnel proposed under 8.1D Mod 5. This tunnel, unlike the mainline Project tunnel in the downtown area, features several sharp curves and rapid transitions in elevation, producing the potential for driver disorientation. On February 9, 1993, MHD informed EOE/MEPA of the issues raised by FHWA and USACE. Notice was published in the *Environmental Monitor* that MHD would, in direct response to FHWA and USACE concerns, consider a Non-River-Tunnel Alternative in this DSEIS/R.

The final FHWA Scope of Work for this DSEIS/R was issued February 12, 1993. The Scope required the comparison of two design alternatives, a Non-River-Tunnel Alternative and a reduced River-Tunnel Alternative, both refinements of Alternative 8.1D Mod 5. The EOE/MEPA final certificate required the evaluation of all three of the new design alternatives presented in this DSEIS/R.

The FHWA Scope of Work and the EOE/MEPA Certificate on the NPC may be found in the Comments and Coordination section of this report.

1.5 REGULATORY FRAMEWORK AND COMPLIANCE

Many of the activities to be undertaken in implementing the Project, including the Charles River crossing within the Area North of Causeway Street, are subject to Federal and State regulatory jurisdiction. (Because the Massachusetts Highway Department is a State agency, it is not legally subject to ordinances or local permits except to the extent that the Massachusetts Legislature has specifically determined it to be appropriate for State agencies to submit to local jurisdiction, such as in the case of certain environmental permitting processes.) A number of Federal and State permits required for the Project have been issued, and other permit applications are pending, based on plans and technical studies evaluated in the 1985 FEIS/R and the 1991 FSEIS/R. The Projectwide FEIS/R and FSEIS/R, including their appendices and related technical support documents, although not intended to serve as actual permit applications, presented extensive data and information to support environmental and construction permit applications. A more detailed discussion of Charles River crossing permit and regulatory requirements can be found in the Appendix of this DSEIS/R.

This Charles River crossing DSEIS/R and its supporting documents provide additional technical information to facilitate continued decision-making by permit agencies on those permits specifically applicable to the crossing. Continuing discussion with agencies, particularly through the Interagency

Coordinating Committee and one-on-one meetings, have guided the specific technical analyses undertaken for this DSEIS/R. The Project will work closely with applicable permit agencies reviewing the DSEIS/R to facilitate coordination of permit reviews by agencies with overlapping jurisdiction, especially in the water resource area.

1.6 ORGANIZATION OF THE DSEIS/R

The purpose of this DSEIS/R is to present a comparison of Scheme Z, Alternative 8.1D Mod 5, the Reduced River-Tunnel Alternative, and the Non-River-Tunnel Alternative, based on all impacts discussed in the 1991 FSEIS/R. Chapters 2 through 5 present the following topics for the affected subarea only:

- Alternatives: Chapter 2 presents a comparison of Scheme Z and the three new design alternatives.
- Affected Environment: Chapter 3 presents a brief description of existing conditions in the Area North of Causeway Street, including the major changes since the publication of the FSEIS/R in November 1990. Where appropriate for comparative purposes, and to improve understanding, the topic of "affected environment" addressing a specific subject is presented in Chapter 4, entitled Environmental Consequences, rather than in Chapter 3.
- Environmental Consequences: Chapter 4 compares Scheme Z to the three new alternatives in terms of traffic and transportation; land use, including recreational use; air quality; noise and vibration; aquatic resources; threatened and endangered species; historic and archaeological preservation; hazardous waste sites; visual impacts; energy; the relationship of short-term uses versus long-term productivity; and irreversible and irretrievable commitment of resources.
- Construction Impacts: Temporary short-term impacts during construction are identified in Chapter 5.
- Other required supplementary information is located at the end of the DSEIS/R. Appendices with supporting data and the DSEIS/R Index are located in separate volumes.
- The Draft Section 4(f) Evaluation: The Section 4(f) Evaluation, an independent document outlining Project impacts on parklands and historic resources and potential mitigation measures, is published at the end of the DSEIS/R.

2. Alternatives

Chapter 2

ALTERNATIVES

2.1 DESCRIPTION OF ALTERNATIVES

Chapter 1 provides a concise discussion of how and why reasonable alternatives were selected for detailed study. This chapter, specifically in Sections 2.2 through 2.5, provides a detailed description of the 1991 Proposed Action (Scheme Z) and the three new design alternatives which are evaluated in this DSEIS/R:

- 1991 FSEIS/R Proposed Action (Scheme Z)
- 1992 NPC Alternative 8.1D Modified 5
- 1993 DSEIS/R Reduced River-Tunnel Alternative
- 1993 DSEIS/R Non-River-Tunnel Alternative

The objective of this DSEIS/R analysis is to compare the three new design alternatives with Scheme Z and with each other. Section 2.2 describes Scheme Z, followed by descriptions of the three new design alternatives in Sections 2.3 through 2.5. In addition, structures required for Scheme Z and the three new alternatives are identified and briefly described.

While the descriptions include a discussion of bridge types, once the environmental process concludes and a preferred alternative is selected, FHWA will require a bridge-type study to analyze cable-stayed, tied-arch, truss, and other possible long-span alternatives (see Figure 2.1). MHD is committed to building a long-span "signature" bridge across the Charles River, and favors a cable-stayed structure, as developed during the BDRC process. Table 2.1 compares major features of all four designs. Tables 2.2 through 2.5 summarize major travel routes from four origins to six destinations under each design for comparative evaluation, and are located at the end of Section 2.5.

Plan views of the of the Charles River bridge for Scheme Z and the three new design alternatives are shown in Figure 2.22 and 2.23, and elevations of the Charles River bridge are shown in Figures 2.24 and 2.25. Sections of the loop ramp on the north bank of the Charles River are shown in Figures 2.26 through 2.29. These figures are located at the end of Section 2.5.

The chapter concludes with Section 2.6, Design Refinements to Alternatives. Three figures (2.30 through 2.32) showing these refinements in comparison to each affected alternative follow the text.

2.2 SCHEME Z

The discussion of the 1991 Proposed Action in this DSEIS/R focuses on Scheme Z as approved in 1991. Subsequent refinements to Scheme Z are not discussed in detail in this DSEIS/R. The structures of Scheme Z are shown in Figure 2.2, and main travel routes of Scheme Z are shown in Figures 2.3 through 2.6.

2.2.1 Scheme Z Structures

Scheme Z features two cable-stayed bridges with towers on both sides of the Charles River. In addition, it requires a double-decked bridge that differs in type and profile from the main bridge, for a total of three bridge structures. Since there are no tunnels in Scheme Z, ventilation buildings are not required.

2.2.2 Scheme Z Roadway Links

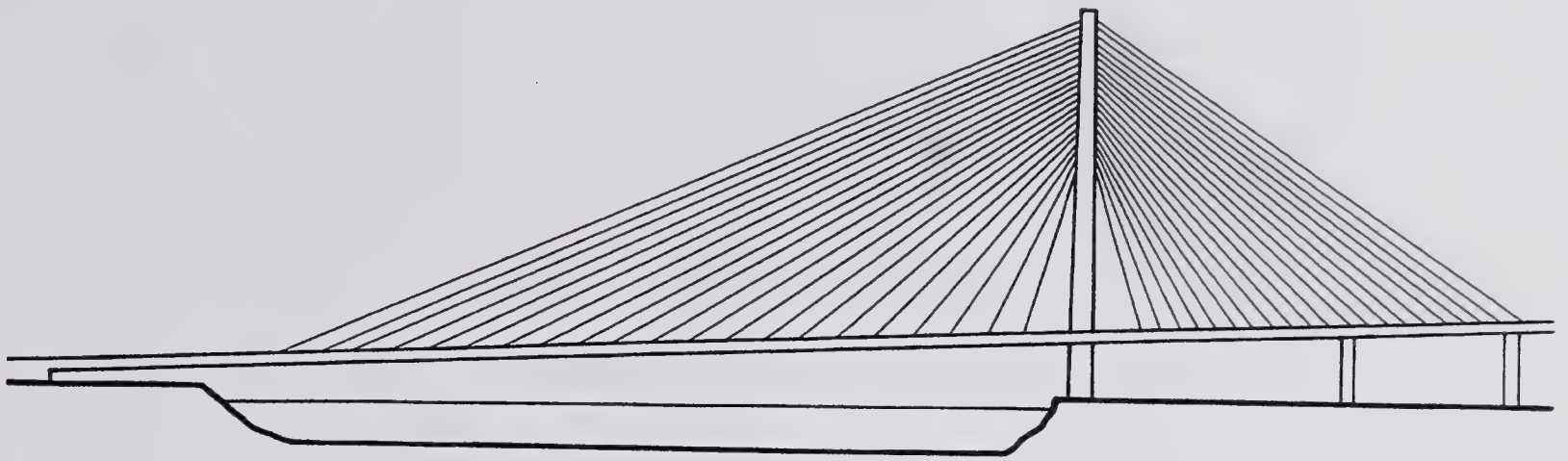
The I-93 mainlines over the Charles River are on two bridges, each comprised of five lanes in either direction. In addition, a six-lane (three-over-three) double-decked structure is required to accommodate traffic movements to and from Leverett Circle/Storrow Drive, for a total of 16 lanes over the river.

The southbound Route 1 (Tobin Bridge) to Storrow Drive and I-93 southbound traffic movements are accommodated on two viaduct structures in East Cambridge with local access connections at Leverett Circle. Regional connections are provided to the north on viaduct with local access provided to Rutherford Avenue and Charlestown.

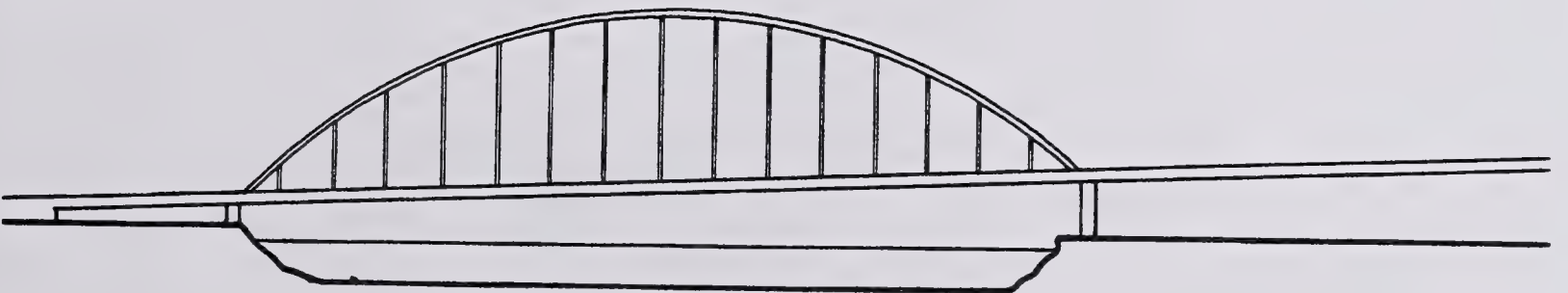
Travelling south on I-93, traffic movements to Storrow Drive are provided on a viaduct loop in East Cambridge. The Route 1 (Tobin Bridge) northbound move is accommodated by the viaduct connections in East Cambridge. Local access to Charlestown is provided at City Square.

Traffic movements from I-93 northbound to Storrow Drive westbound are provided via the mainline crossing northbound over the Charles River, reversing direction on a loop ramp that crosses southbound over the river a second time on the lower level of the double-decked bridge, and through the North Station area connecting to Storrow Drive. Local connections are provided to East Cambridge and downtown Boston on the south side of the river at Leverett Circle. Access to Route 1 (Tobin Bridge) northbound is provided by a viaduct north of the Charles River. Local access to East Cambridge and Charlestown is provided at City Square.

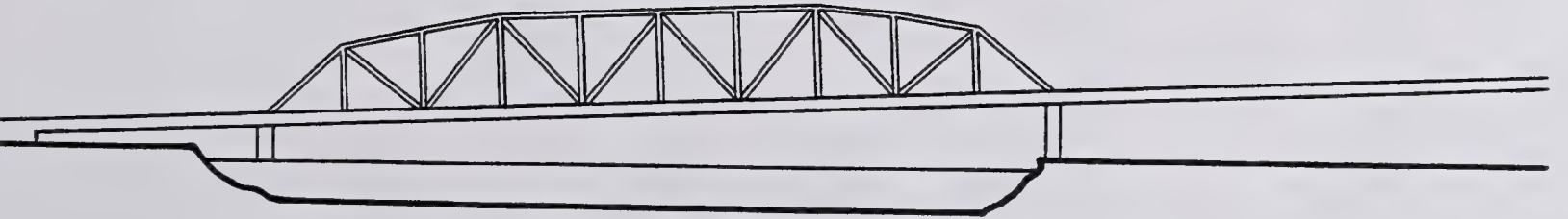
Traffic movements from Storrow Drive to I-93 southbound are provided via a northbound traffic movement first across the Charles River on the upper level of the double-decked bridge, and looping back on a viaduct connection to I-93 southbound then crosses the river a second time on the mainline bridge. As a result, it adds two lanes to the river crossing and one loop to the six-loop interchange in East Cambridge/Charlestown. Local on-ramps to I-93 at Leverett Circle are included.



Cable-Stayed Bridge



Tied-Arch Bridge



Long-Span Truss Bridge

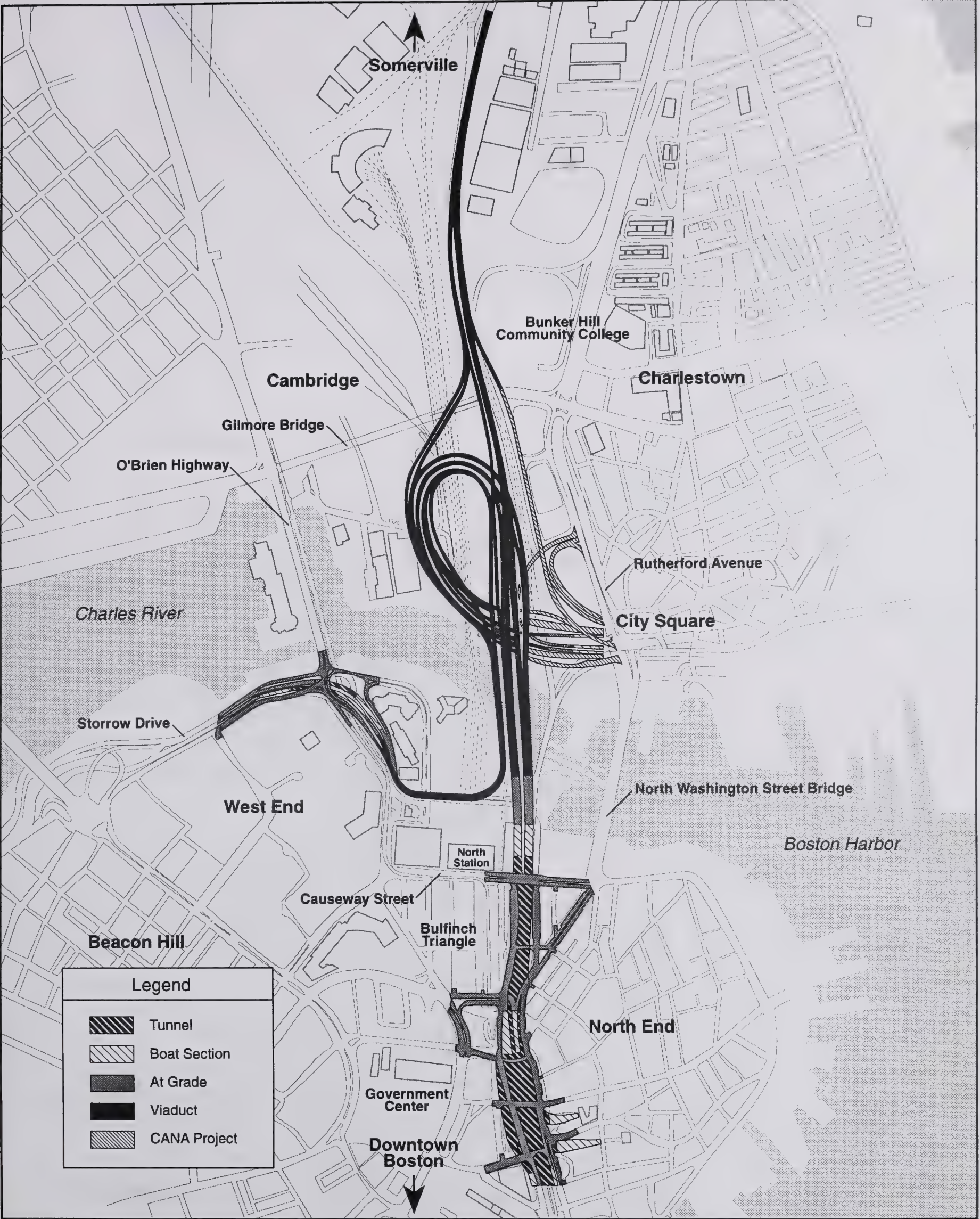
FIGURE 2.1	Elevations Of Typical Long-Span Bridges Charles River Crossing DSEIS/R	MASSACHUSETTS HIGHWAY DEPARTMENT CENTRAL ARTERY/TUNNEL PROJECT	
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Table 2.1

COMPARISON OF MAJOR FEATURES

Major Features	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
Charles River Bridges:				
Number of lanes	16	10	12	14
Number of bridge structures	3	1	1	2
Number of mainline bridge towers	2 (north & south)	1 (north)	2 (north & south)	2 (north & south)
Tunnels:				
Total linear feet of tunnels	0	10,100 ³	6,150 ⁴	3,300 ⁴
Number of lanes in river tunnel	0	3	2	0
Number and location of ventilation buildings	0	1 (south bank at Spaulding Hospital site, above grade)	2 (south bank: between Nashua Street and MBTA railroad tracks; north bank: at BSG)	1 (south bank between Registry Building and Nashua Street)
Central Artery to Tobin Bridge move	on viaduct	in tunnel	on viaduct	on viaduct
Loop ramps north of Charles River	6	1	2	2 to 3
HOV lane (I-93 southbound)	no ¹	yes	yes	yes
Direct access ramp from Government Center/downtown Boston	no ²	yes	yes	yes
Storrow Drive to I-93 move at Leverett Circle	new underpass next to existing underpass (1-level)	at grade	new underpass beneath existing underpass (2-level)	new underpass next to existing underpass (1-level)
Construction and Right-Of-Way Cost estimates (in millions of 1993 dollars)	\$489	\$1,282	\$1,131	\$995
Construction duration (years)	8.5	13	9	8.5

¹ Scheme Z, as approved, contains an HOV lane on the Nashua Street off ramp only.² Scheme Z, as approved, does not include an on-ramp at Traverse Street to I-93 northbound.³ October 1992 estimates⁴ March 1993 estimates



FIGURE

Scheme Z

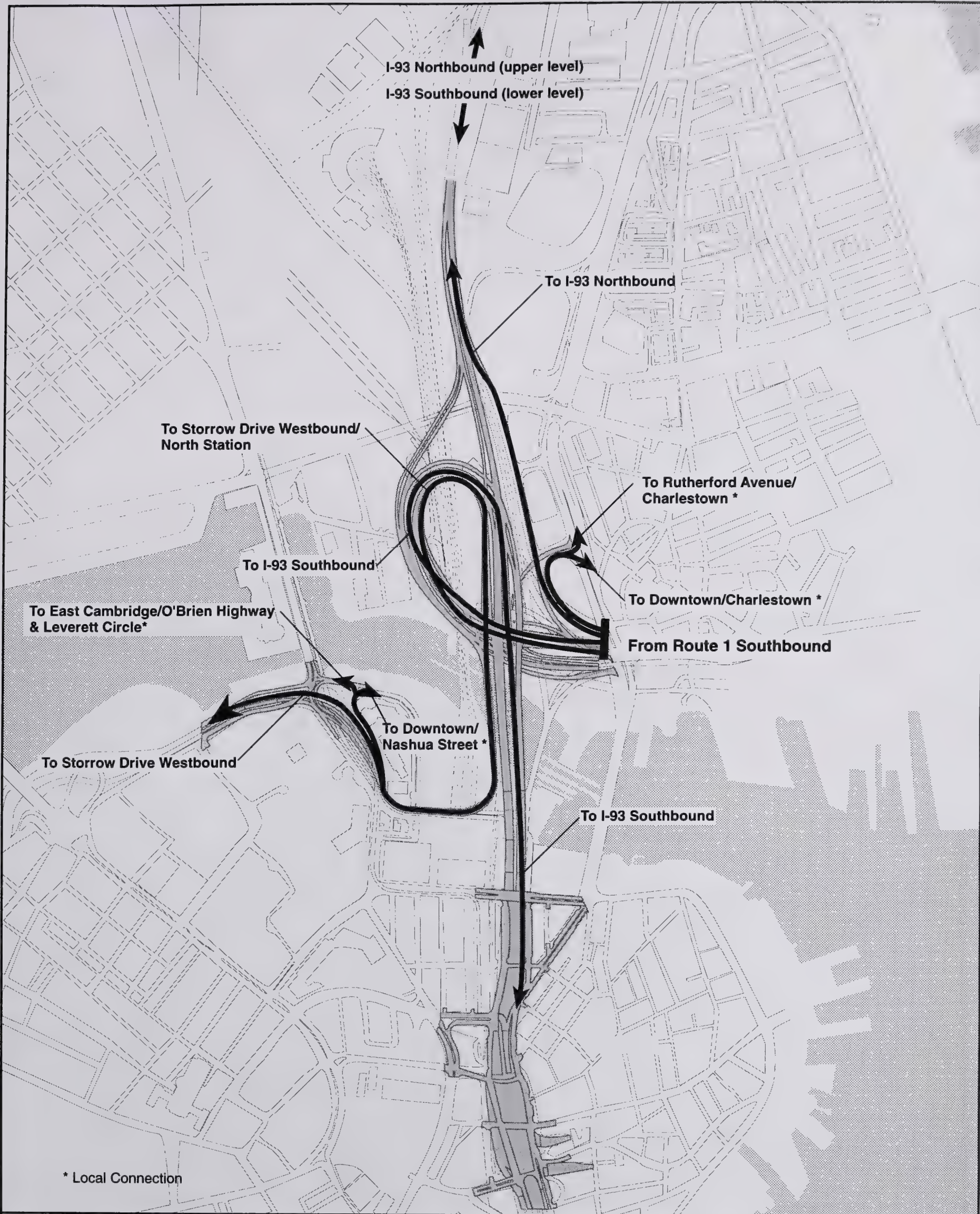
Charles River Crossing DSEIS/R

2.2

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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FIGURE

2.3

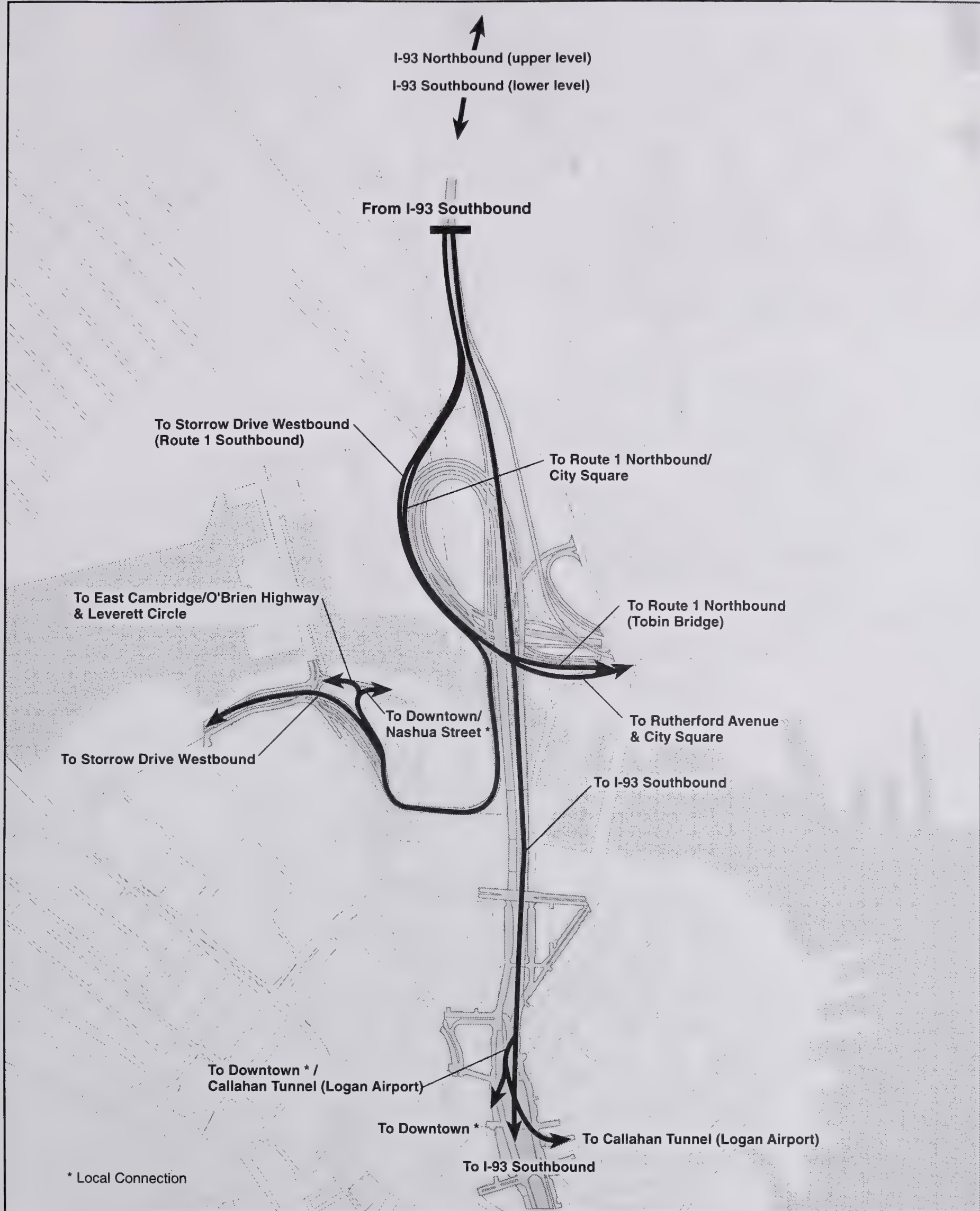
Travel Routes From Route 1 Southbound: Scheme Z

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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FIGURE

2.4

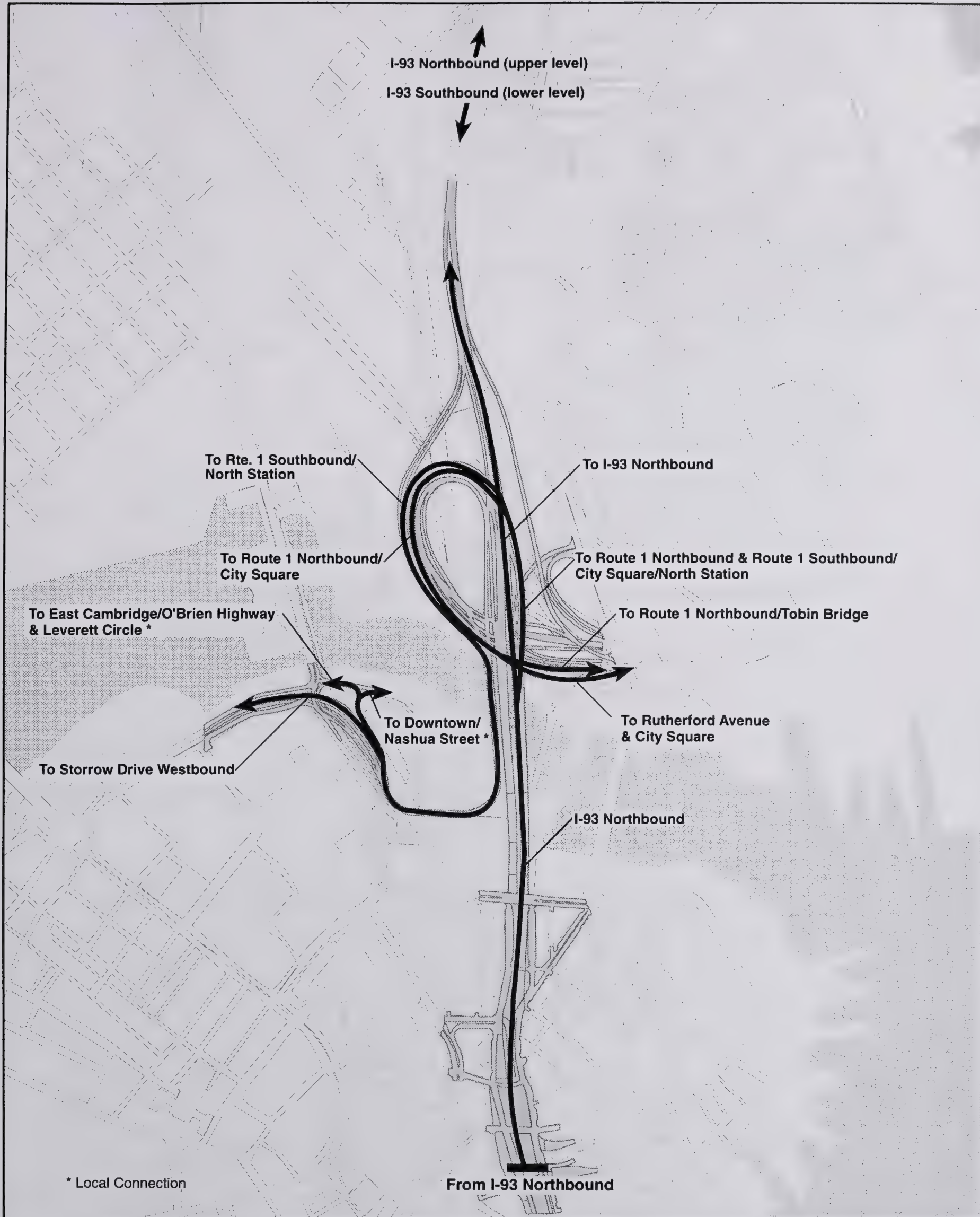
Travel Routes From I-93 Southbound: Scheme Z

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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FIGURE

2.5

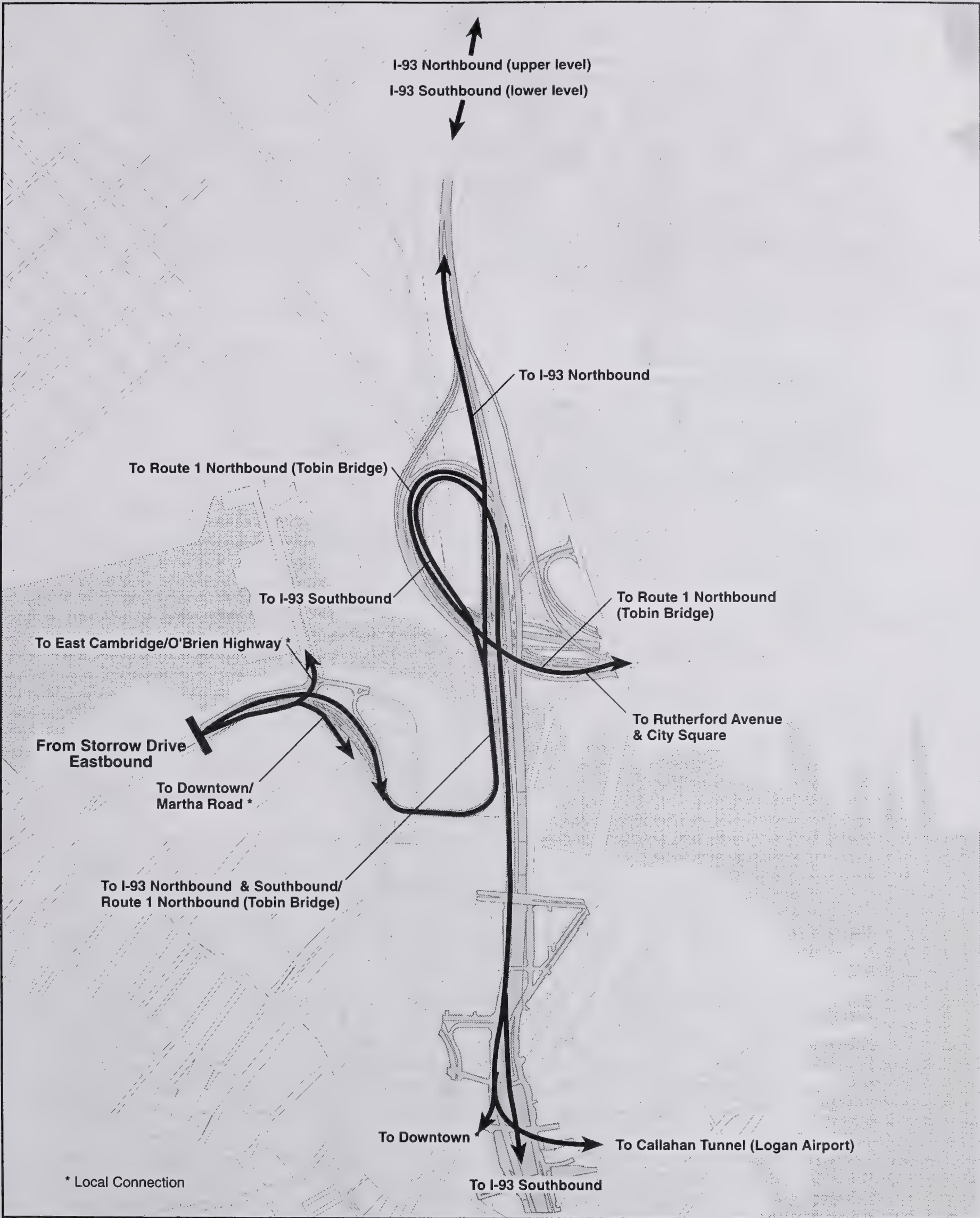
Travel Routes From I-93 Northbound: Scheme Z

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





FIGURE

2.6

Travel Routes From Storrow Drive Eastbound: Scheme Z

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



2.3 ALTERNATIVE 8.1D MOD 5

For the purposes of this DSEIS/R, Alternative 8.1D Modified 5 is analyzed on the basis of the design shown in the 1992 NPC, with additional qualitative discussion, as appropriate, of the applicability of further design refinements. The main feature of this design is that over 10,000 linear feet (lf) of structure are in tunnel; the greatest length of structure in tunnel of any of the three alternatives. Alternative 8.1D Mod 5 includes a 10-lane mainline bridge and a single loop ramp in East Cambridge. The structures and main travel routes for Alternative 8.1D Mod 5 are shown in Figures 2.7 through 2.11.

2.3.1 Alternative 8.1D Mod 5 Structures

As described in the NPC, the bridge includes a cable-stayed structure with a single twin-legged tower along the north side of the Charles River. In addition, a ventilation building located south of the Charles River is required to service the three-lane northbound tunnel under the river and the land-based tunnels under East Cambridge, the North Station commuter railroad tracks, the Spaulding Rehabilitation Hospital and Nashua Street. The size of this ventilation building and the location of the three-lane northbound tunnel under the Charles River require this building to be built above grade. Exhaust stacks and fresh air intake stacks will extend from the roof of the ventilation building.

2.3.2 Alternative 8.1D Mod 5 Roadway Links

In Alternative 8.1D Mod 5, the I-93 mainline highway crosses over the Charles River on a single bridge consisting of four lanes each in northbound and southbound directions. An additional two lanes on the western side of the mainline bridge carry I-93/Route 1 southbound traffic to Leverett Circle/Storrow Drive, for a total of 10 lanes over the river.

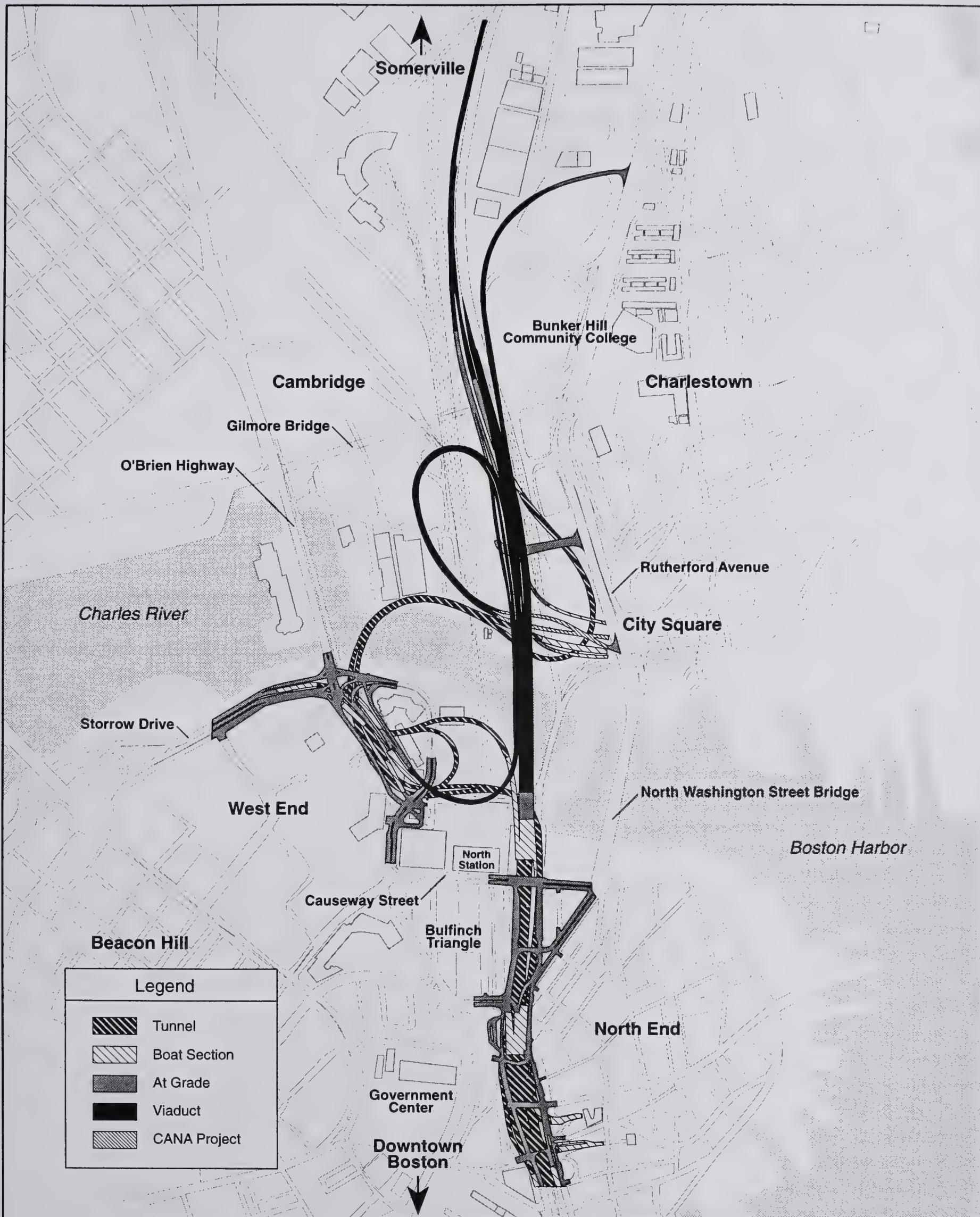
Travelling south on Route 1 (Tobin Bridge), the traffic movement to Storrow Drive and I-93 southbound is accommodated by one viaduct with local access connections at Leverett Circle. Regional connections to the north are provided via a surface road with local access to Rutherford Avenue and Charlestown. Regional access to Boston Sand and Gravel Company (BSG) is via northbound and southbound ramps between Route 1 and I-93, and local access is provided via Rutherford Avenue.

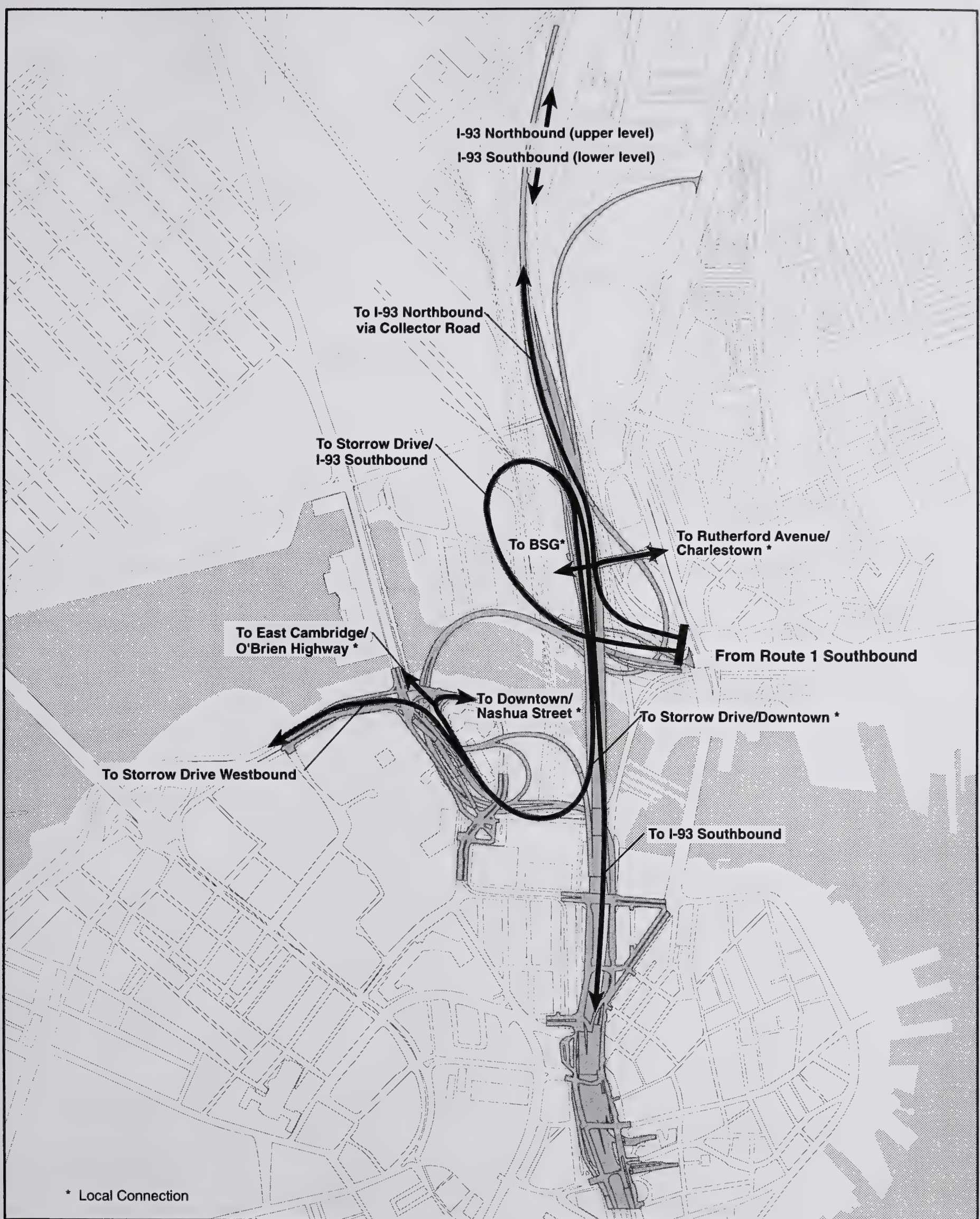
I-93 southbound traffic movements to Storrow Drive are provided on viaducts and bridge. Local access to East Cambridge, the O'Brien Highway, and downtown Boston is provided at Nashua Street. I-93 southbound traffic to Route 1 (Tobin Bridge) northbound is accommodated via a surface road connection under the I-93 southbound mainline with an at-grade signalized intersection that provides local access to Rutherford Avenue and BSG. An exclusive HOV lane is provided on I-93 southbound from Sullivan Square in Somerville to the north bank of the Charles River.

Traffic movements are provided from I-93 northbound to Storrow Drive westbound by direct tunnel through the North Station area. Local connections are provided to East Cambridge and downtown Boston on the south side of the river at Leverett Circle. I-93 northbound traffic to Route 1 (Tobin Bridge) northbound is accommodated in a tunnel through North Station and under the Charles River. North of the Charles River, local access to East Cambridge and Charlestown is via Rutherford Avenue north of the Gilmore Bridge. Local access is provided from downtown Boston at New Sudbury Street.

Traffic movements from Storrow Drive to I-93 southbound are provided by tunnel through the North Station area. Traffic movements to I-93 northbound and Route 1 (Tobin Bridge) northbound are provided by a tunnel connection which loops around northwesterly under the site of the Boston Thermal

Corporation's Minot Station steam generating plant, beneath the relocated MBTA Green Line, and under the Charles River in a three-lane tunnel. Local on-ramps to I-93 at Leverett Circle are provided.





FIGURE

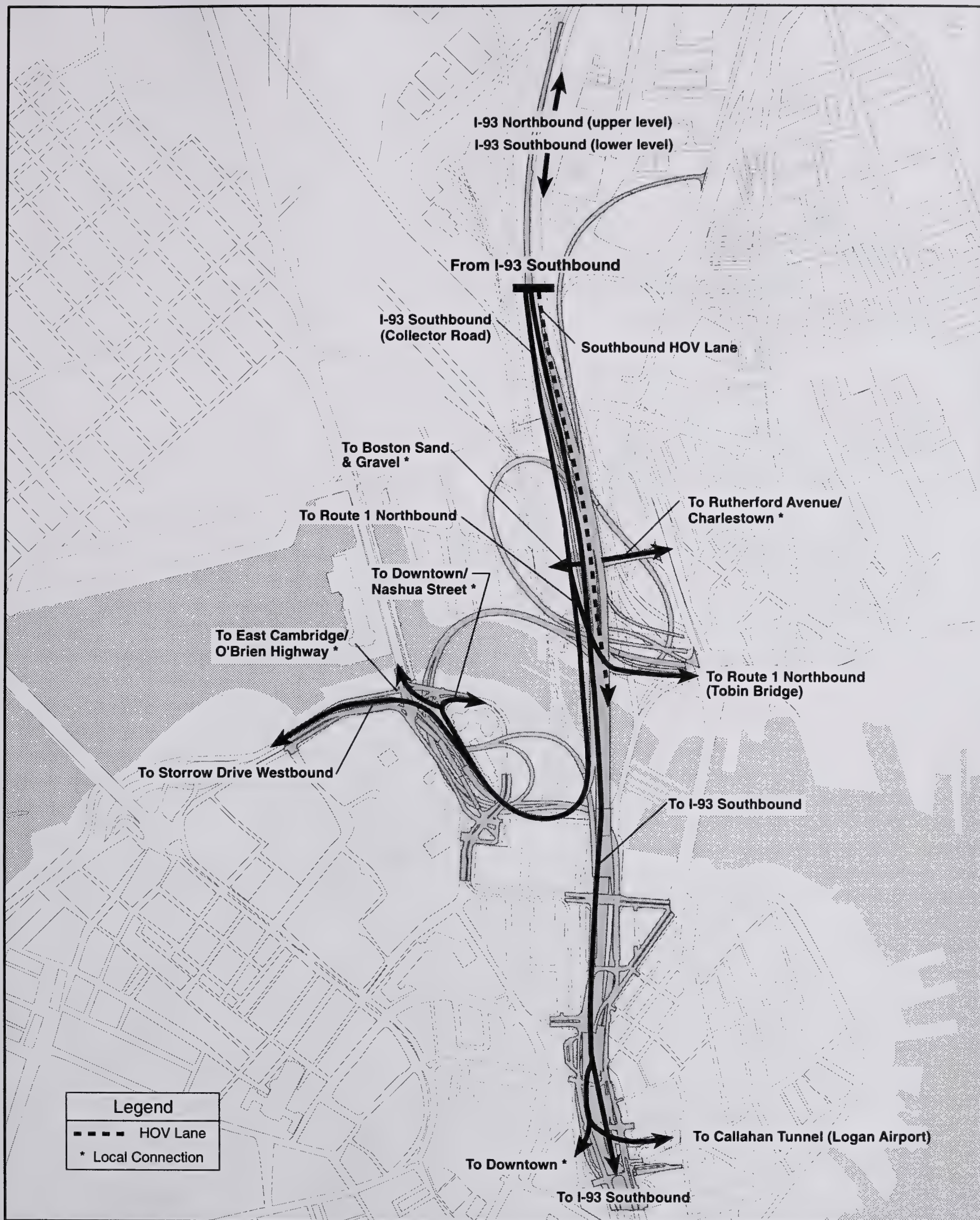
2.8

**Travel Routes From
Route 1 Southbound:
Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





FIGURE

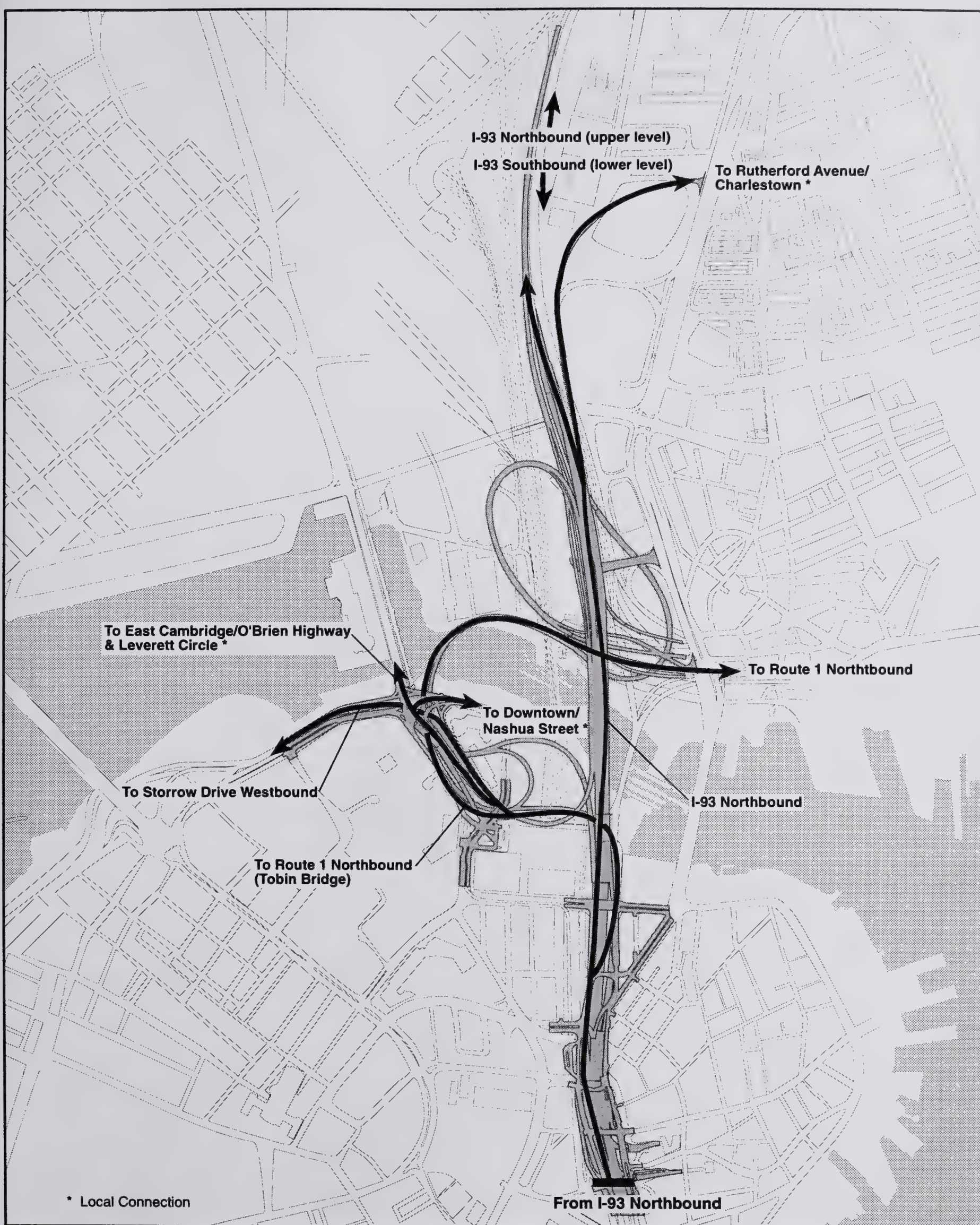
2.9

**Travel Routes From
I-93 Southbound:
Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





FIGURE

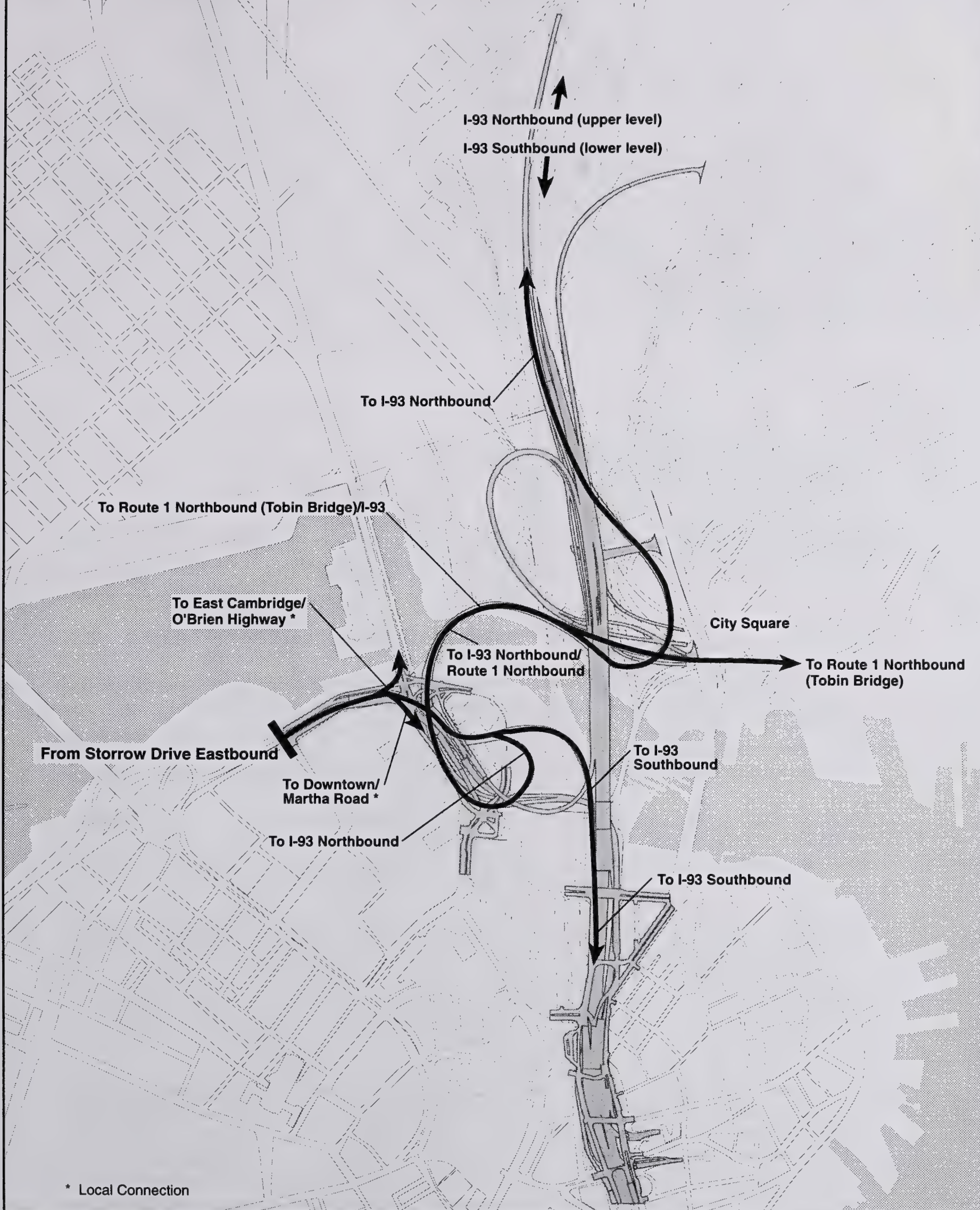
2.10

**Travel Routes From
I-93 Northbound:
Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





2.4 REDUCED RIVER-TUNNEL ALTERNATIVE

The Reduced River-Tunnel Alternative represents a revision of Alternative 8.1D Mod 5. FHWA expressed concerns about Alternative 8.1D Mod 5 regarding traffic operations at Leverett Circle and operational safety in its river tunnel. The USACE expressed additional concerns regarding impacts of tunnel construction in the Charles River. In response to these concerns, the Reduced River-Tunnel Alternative removes the Central Artery to Tobin Bridge movement from tunnel and places it on a viaduct structure by adding two lanes to the mainline bridge. The result is a 4,000-lf decrease in tunnel length. The Reduced River-Tunnel Alternative features two loop ramps in East Cambridge and a 12-lane bridge across the Charles River. The structures of the Reduced River-Tunnel Alternative are shown in Figure 2.12, and main travel routes for the Reduced River-Tunnel Alternative are shown in Figures 2.13 through 2.16.

2.4.1 Reduced River-Tunnel Alternative Structures

The Reduced River-Tunnel Alternative bridge, developed as a result of further design efforts after the NPC, is supported with two towers, one on each side of the river. The two-lane northbound tunnel under the Charles River requires one ventilation building on the north side of the river. This ventilation building is located adjacent to BSG and is surrounded by 2 viaduct loops. The land-based tunnels under the North Station commuter railroad tracks require one ventilation building on the south side of the Charles River. The ventilation buildings are constructed below grade, with exhaust stacks and fresh air intake stacks above grade.

2.4.2 Reduced River-Tunnel Alternative Roadway Links

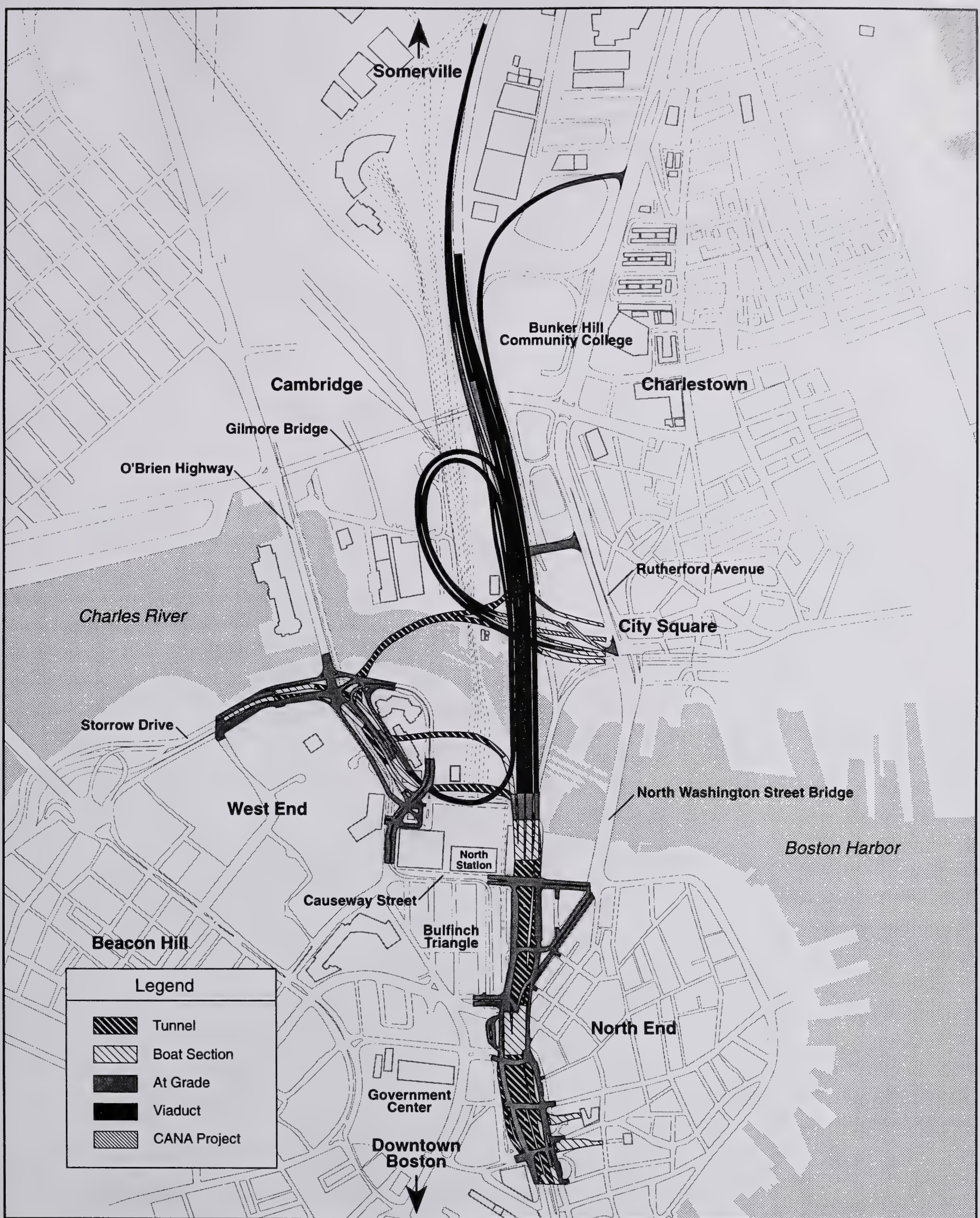
The I-93 mainline highway crosses over the Charles River on a single bridge comprised of a total of 12 lanes. The I-93 mainline crosses the river in eight lanes, four each in north- and southbound directions. Two lanes on the western side of the mainline bridge carry I-93/Route 1 southbound traffic to Leverett Circle/Storrow Drive. An additional two lanes on the eastern side of the mainline bridge carry traffic from downtown and the Sumner Tunnel to I-93 northbound, for a total of 12 lanes over the river.

Travelling south on Route 1 (Tobin Bridge) in Charlestown, the traffic movement to Storrow Drive and I-93 southbound is accommodated by one viaduct loop connection in East Cambridge with local access at Leverett Circle. Regional connections are provided to the north via a surface road with local access provided to Rutherford Avenue, Charlestown, and BSG.

I-93 southbound traffic movements to Storrow Drive are provided on viaducts and bridges. Local access to East Cambridge, O'Brien Highway, and downtown Boston are provided via Leverett Circle/Nashua Street. Traffic to Route 1 (Tobin Bridge) northbound is accommodated via a surface road connection under the I-93 southbound mainline with an at-grade signalized intersection that provides local access to Rutherford Avenue and BSG. An exclusive HOV lane is provided on I-93 southbound from Sullivan Square in Somerville to the north bank of the Charles River.

Traffic movements from I-93 northbound to Storrow Drive westbound are provided by a tunnel through the North Station area. Local connections are provided to East Cambridge and downtown Boston at Leverett Circle. Traffic to Route 1 (Tobin Bridge) is accommodated by a two-lane viaduct north of the Charles River, adding a second loop ramp to the interchange in East Cambridge/Charlestown. Local access to East Cambridge/Charlestown is provided at Rutherford Avenue north of the Gilmore Bridge. Local I-93 access is provided from downtown Boston at New Sudbury Street.

Traffic movements from Storrow Drive to I-93 southbound are provided by a tunnel through the North Station area. Traffic movements to I-93 northbound and Route 1 (Tobin Bridge) northbound are provided in a new eastbound underpass at Leverett Circle and under the Charles River in a two-lane tunnel connecting to the Central Artery North Area (CANA) project in Charlestown. A one-lane exit ramp north of the Charles River provides access to I-93. Local on-ramps are provided to I-93 and Route 1 (Tobin Bridge) at Merrimac Street/Lomasney Way.



FIGURE

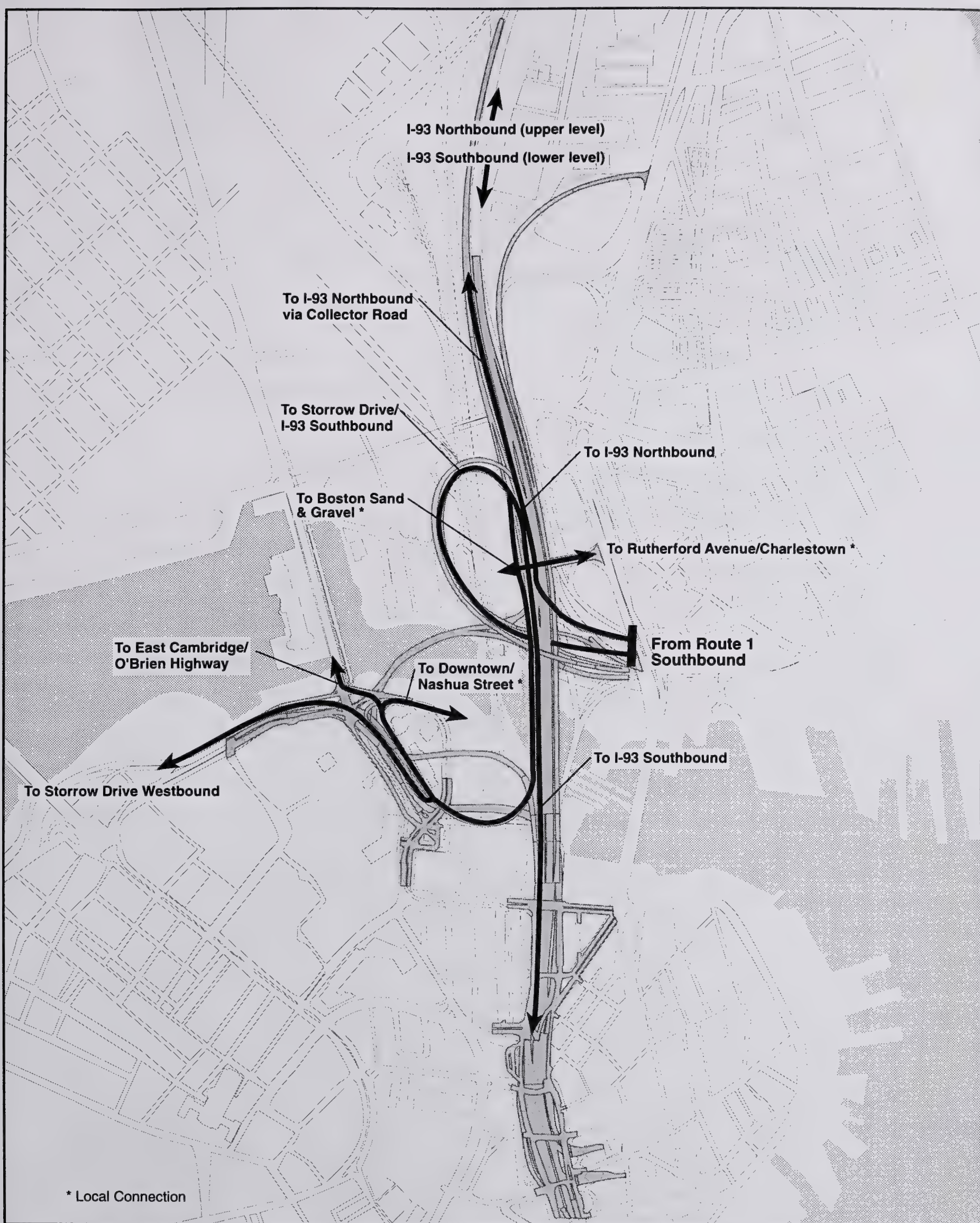
2.12

Reduced River-Tunnel Alternative

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





FIGURE

2.13

Travel Routes From Route 1 Southbound: Reduced River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



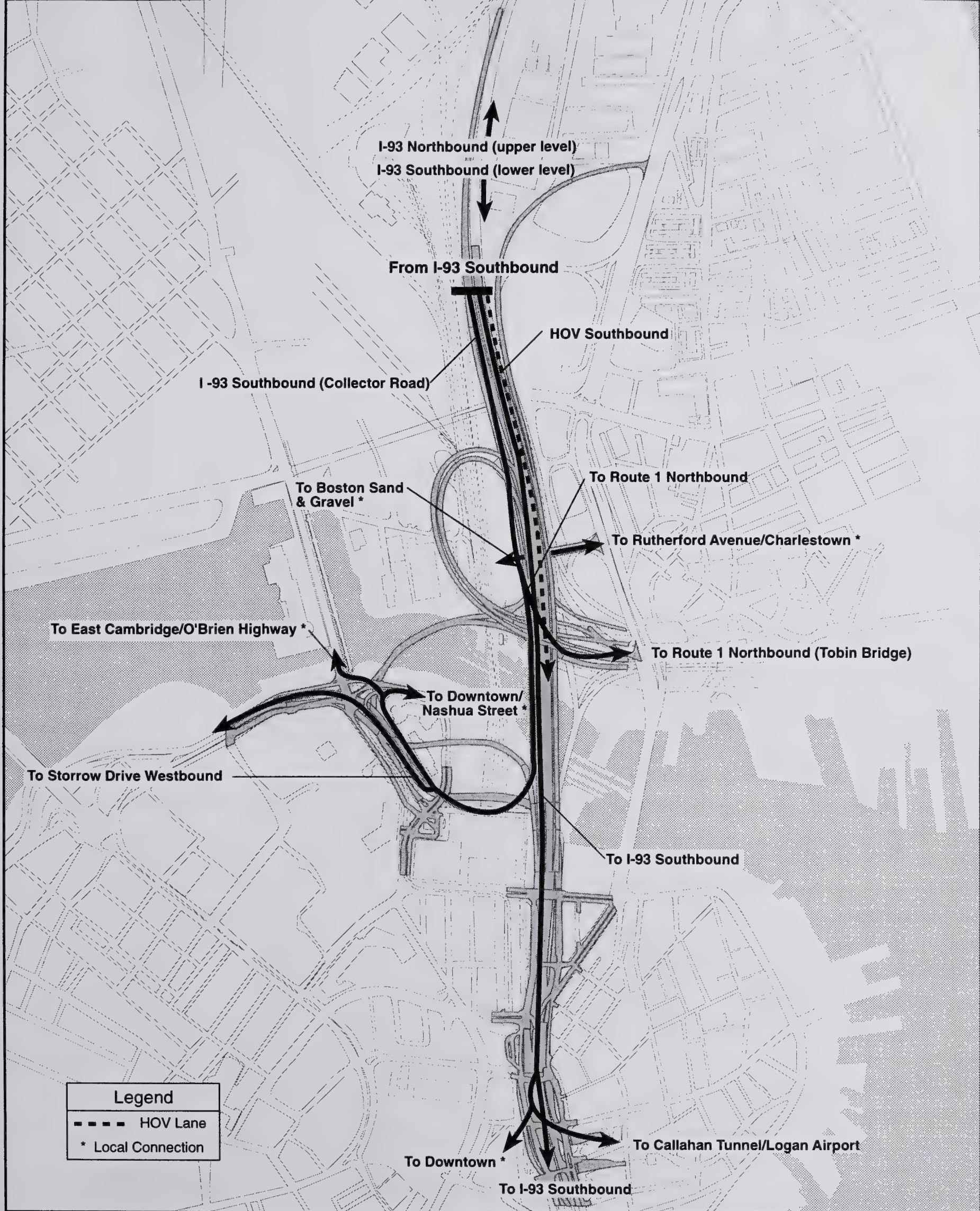


FIGURE 2.14

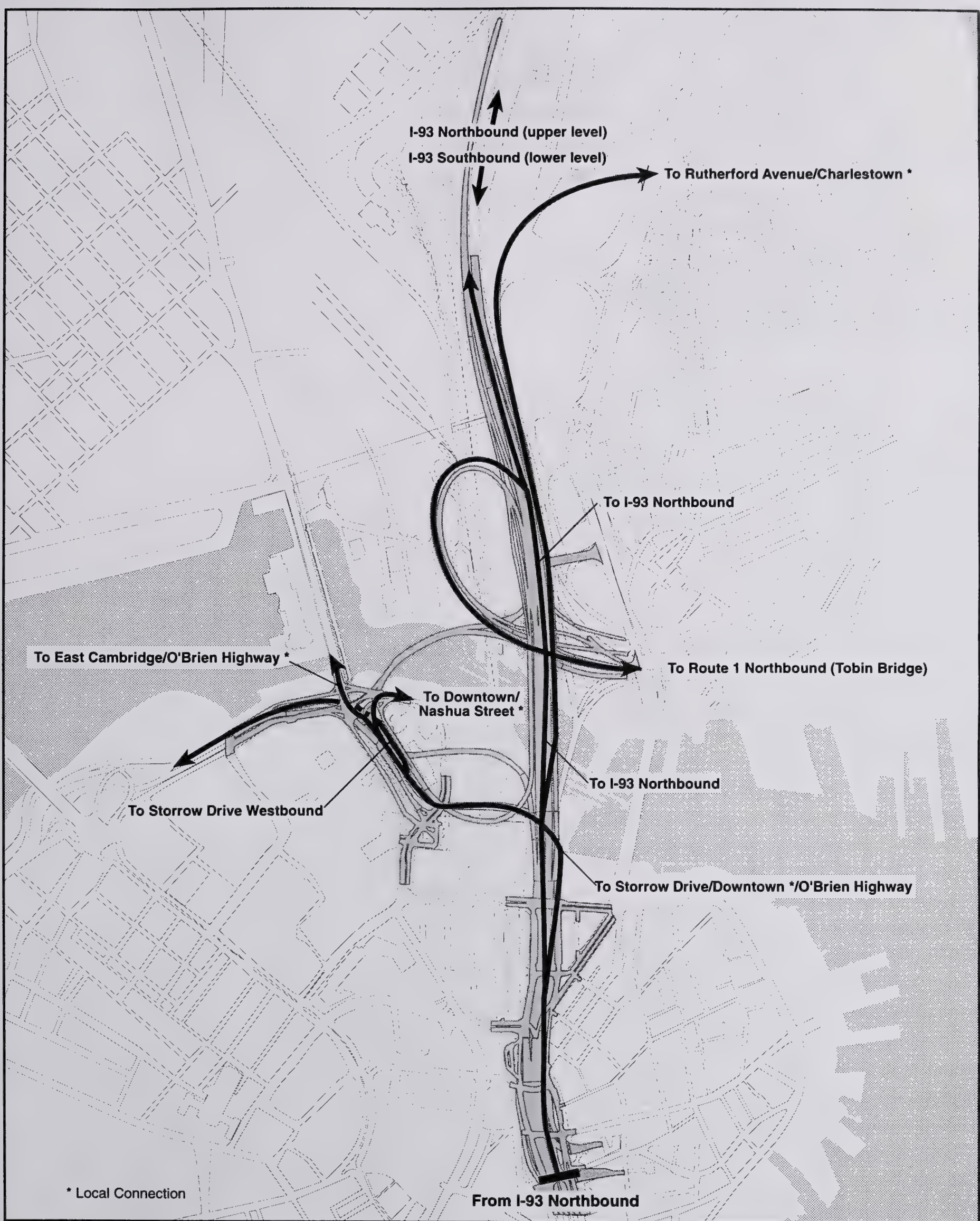
Travel Routes From I-93 Southbound: Reduced River-Tunnel Alternative

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





FIGURE

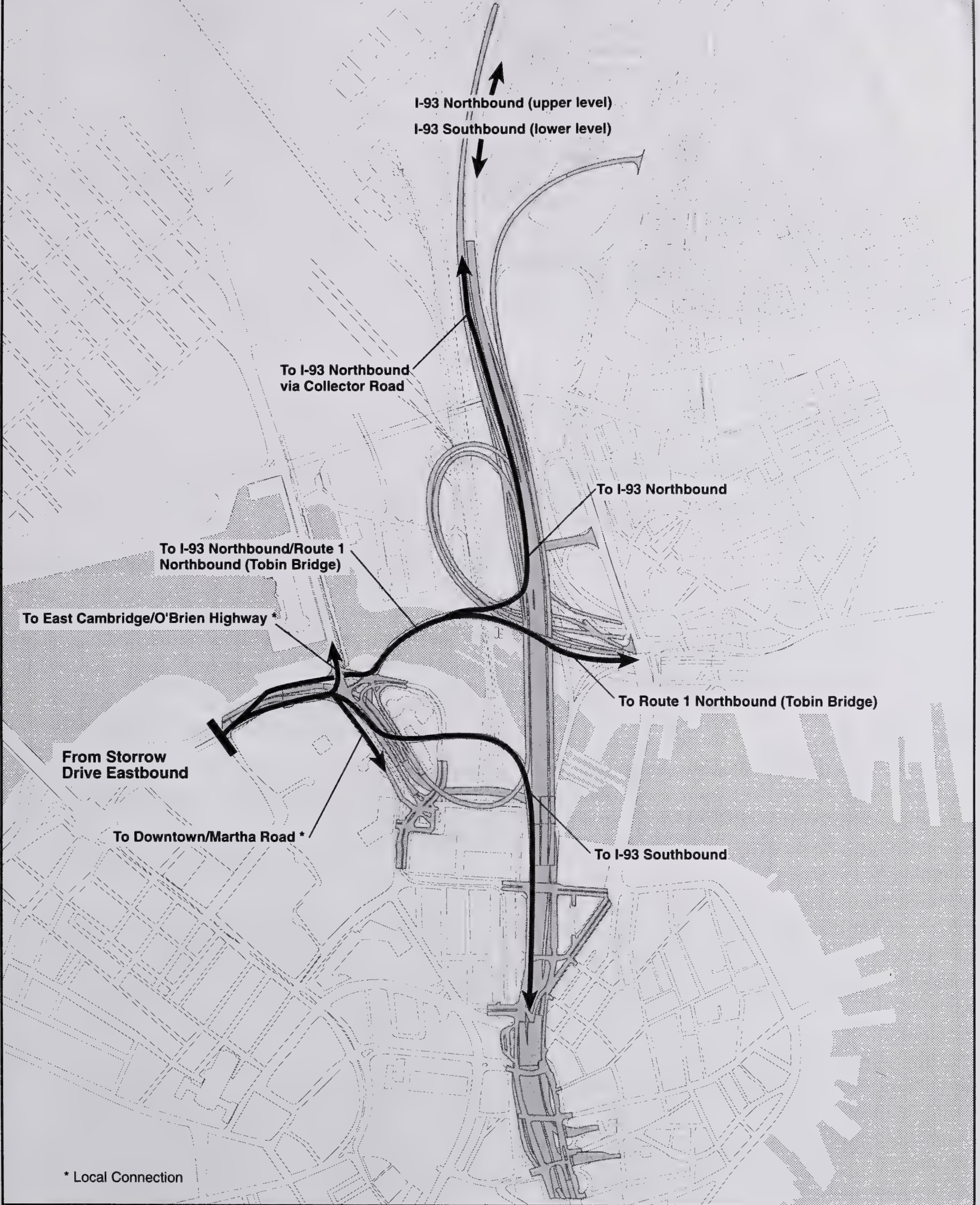
2.15

Travel Routes From I-93 Northbound: Reduced River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





FIGURE

2.16

**Travel Routes From
Storrow Drive Eastbound:
Reduced River-Tunnel Alternative**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



2.5 NON-RIVER-TUNNEL ALTERNATIVE

The Non-River-Tunnel Alternative evolved as a further response to the USACE comments pertaining to the impacts of tunneling in the Charles River and FHWA concerns regarding in-tunnel operational issues. In addition to the refinements made in the Reduced River-Tunnel Alternative, in this alternative the Storrow Drive to Tobin Bridge traffic movement is taken out of tunnel and placed on viaduct. This results in an additional 3,000-lf reduction in tunnel length. The Non-River-Tunnel Alternative features three loop ramps reducing to two loop ramps in East Cambridge, and 14 lanes of traffic crossing the Charles River. The structures of the Non-River-Tunnel Alternative are shown in Figure 2.17, and main travel routes of the Non-River-Tunnel Alternative are shown in Figures 2.18 through 2.21.

2.5.1 Non-River-Tunnel Alternative Structures

The mainline bridge for the Non-River-Tunnel Alternative is a cable-stayed structure with a tower on either side of the Charles River. The second bridge carrying traffic moves to and from Storrow Drive will be in the same visual profile as the mainline bridge. In addition, the land based tunnels under the North Station commuter railroad tracks will require one ventilation building located northwest of the new Boston Garden site. In order to maximize potential future development the ventilation building will be constructed below grade, with exhaust stacks and fresh air intake stacks above grade.

2.5.2 Non-River-Tunnel Alternative Roadway Links

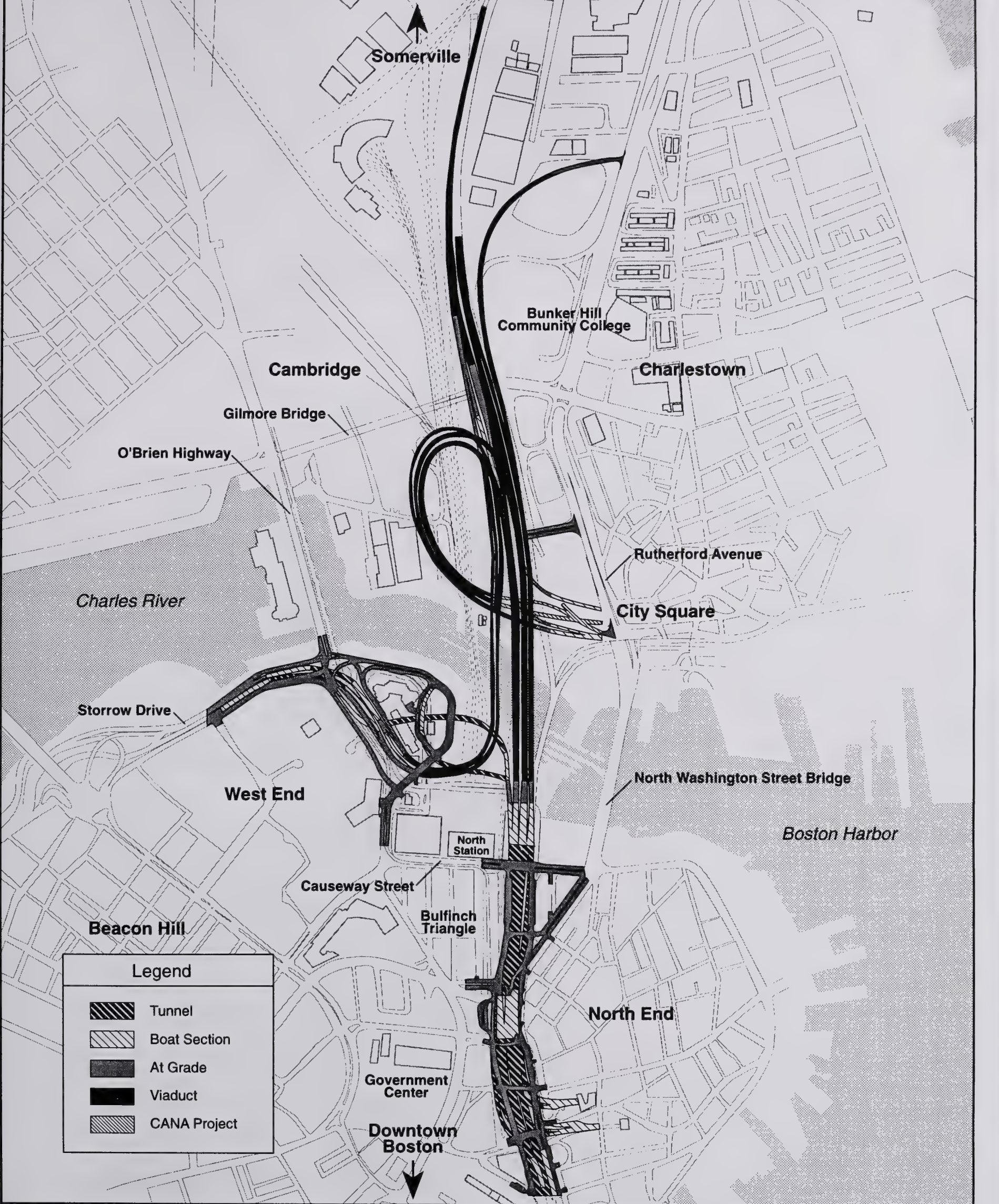
In the Non-River-Tunnel Alternative, the I-93 mainline highway crosses over the Charles River on a single bridge with a total of ten lanes, including four lanes each in the northbound and southbound directions and an additional two lanes on the eastern side of the mainline to carry downtown Boston and Sumner Tunnel traffic to I-93 northbound. Traffic to and from Storrow Drive/Leverett Circle is accommodated on a second four-lane bridge with two lanes each in the northbound and southbound directions for a total of 14 lanes over the river.

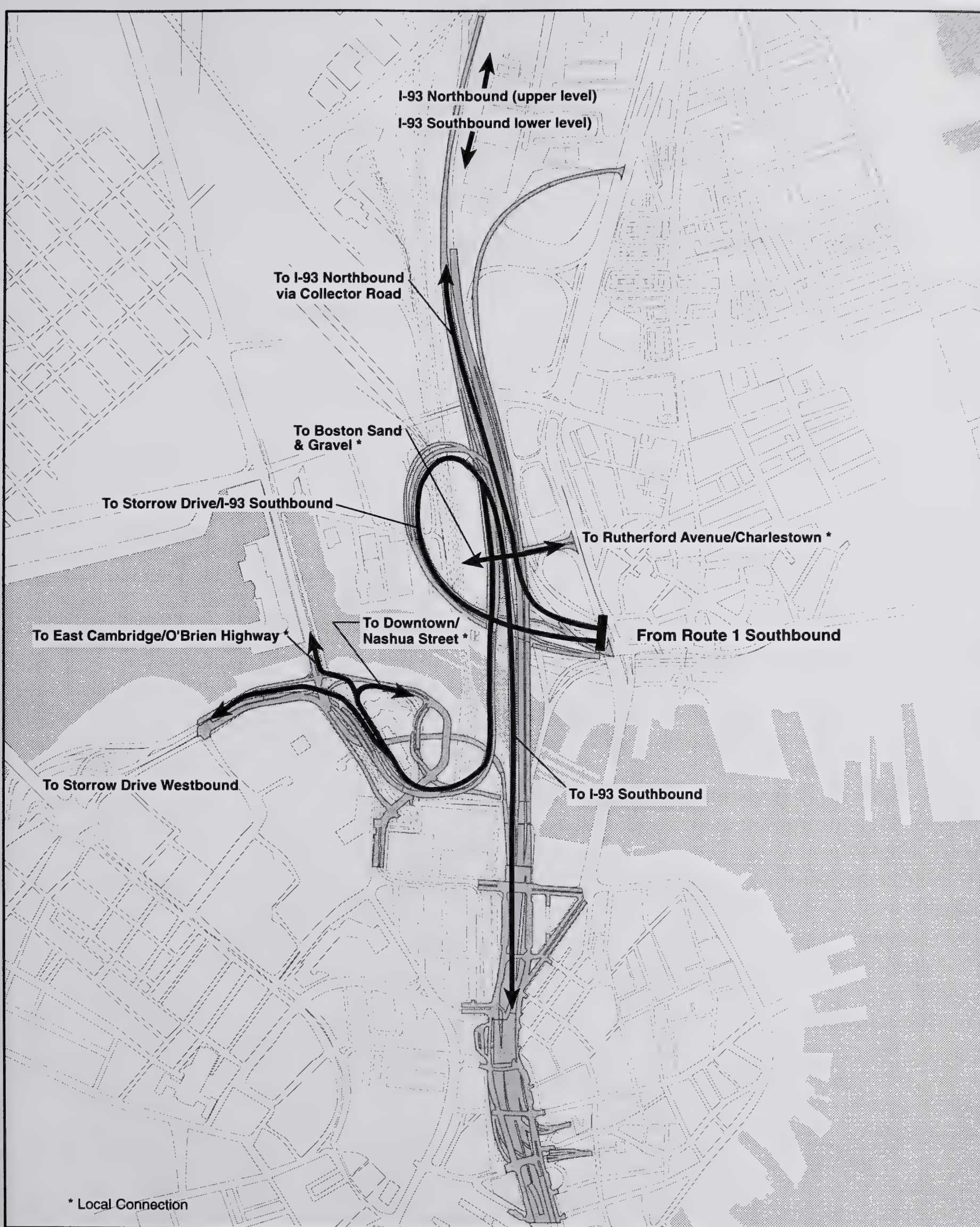
Travelling south on Route 1 (Tobin Bridge) in Charlestown, traffic to Storrow Drive and I-93 southbound is accommodated by viaducts with local access connections at Leverett Circle. This movement has one viaduct loop in Cambridge. Regional connections are provided to the north via a surface road with local access provided to Rutherford Avenue and Charlestown. Direct access is provided to BSG via an at-grade signalized intersection.

I-93 southbound traffic movements to Storrow Drive are provided on viaducts and bridges. Local access is provided to East Cambridge, O'Brien Highway, and downtown Boston. I-93 southbound traffic to Route 1 (Tobin Bridge) northbound is accommodated via a surface road connection under the I-93 southbound mainline with an at-grade signalized intersection that provides local access to Rutherford Avenue and BSG. An exclusive HOV lane is provided on I-93 southbound from Sullivan Square in Somerville to the north bank of the Charles River.

Traffic movements are provided from I-93 northbound to Storrow Drive westbound by tunnel through the North Station area. Local connections are provided to East Cambridge and downtown Boston on the south side of the river at Leverett Circle and Nashua Street. I-93 northbound traffic to Route 1 (Tobin Bridge) is accommodated by a two-lane viaduct north of the Charles River, adding a second loop ramp to the interchange. North of the Charles River, local access to East Cambridge and Charlestown is provided at Rutherford Avenue north of the Gilmore Bridge. Local access to I-93 northbound is provided from downtown Boston at New Sudbury Street.

Traffic movements from Storrow Drive to I-93 southbound are provided by tunnel in the North Station area. Traffic movements to I-93 northbound and Route 1 (Tobin Bridge) northbound are provided in a new eastbound underpass at Leverett Circle and on a bridge structure parallel to the I-93 mainline bridge. Access to Route 1 (Tobin Bridge) adds another partial loop ramp to the interchange in East Cambridge/Charlestown. Local on-ramps to I-93/Route 1 at Leverett Circle are provided.





FIGURE

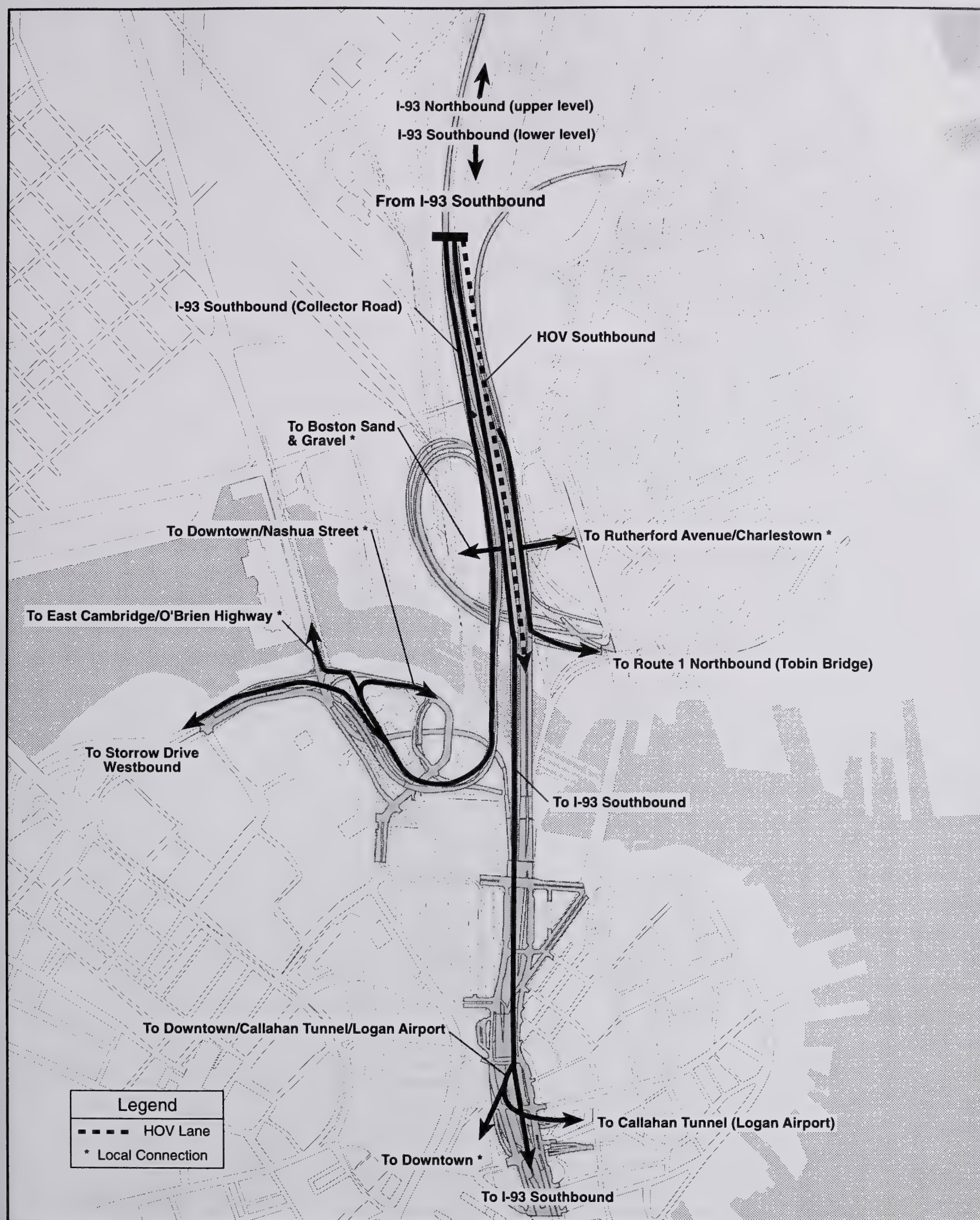
2.18

Travel Routes From Route 1 Southbound: Non-River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





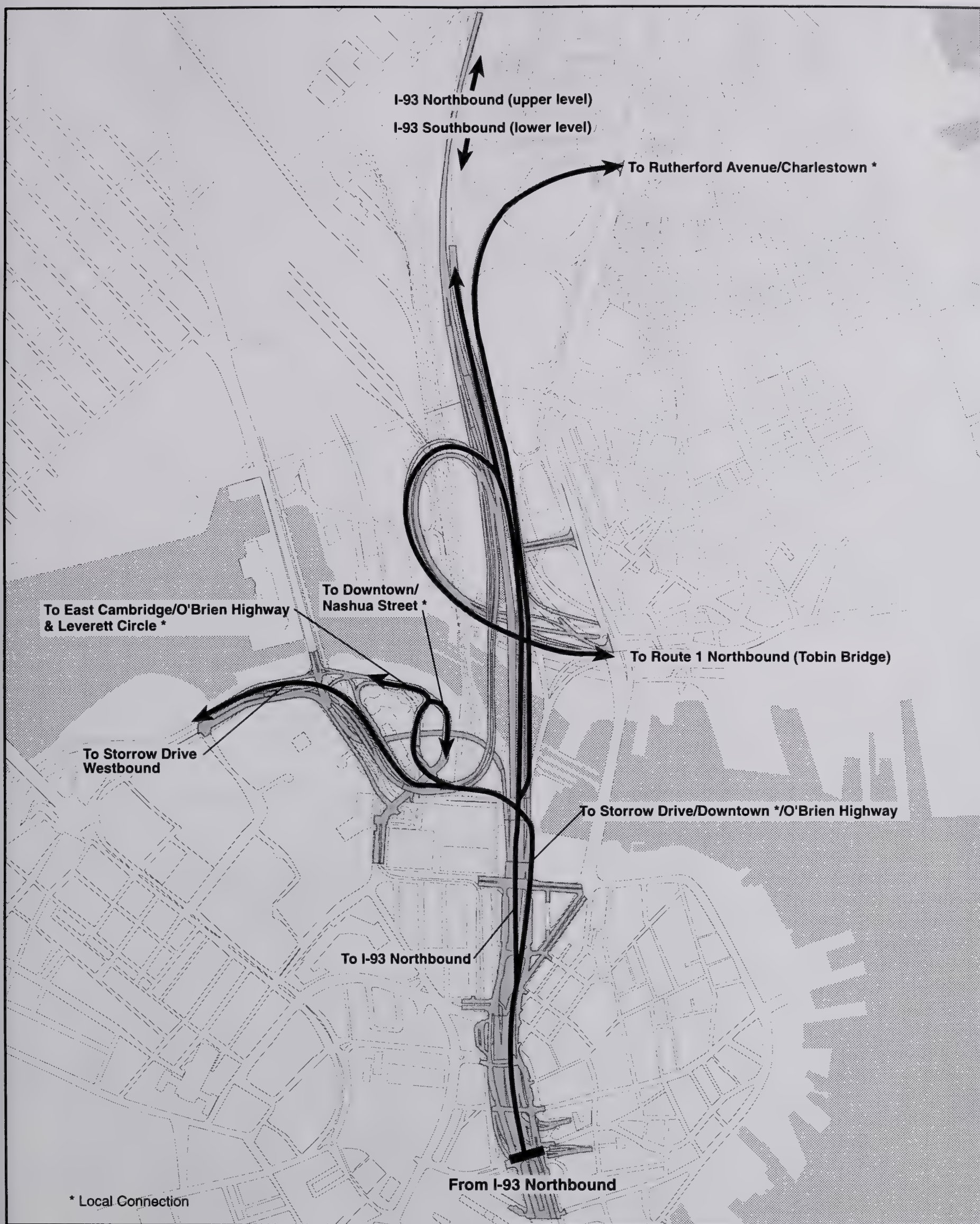
FIGURE

2.19

Travel Routes From I-93 Southbound: Non-River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





FIGURE

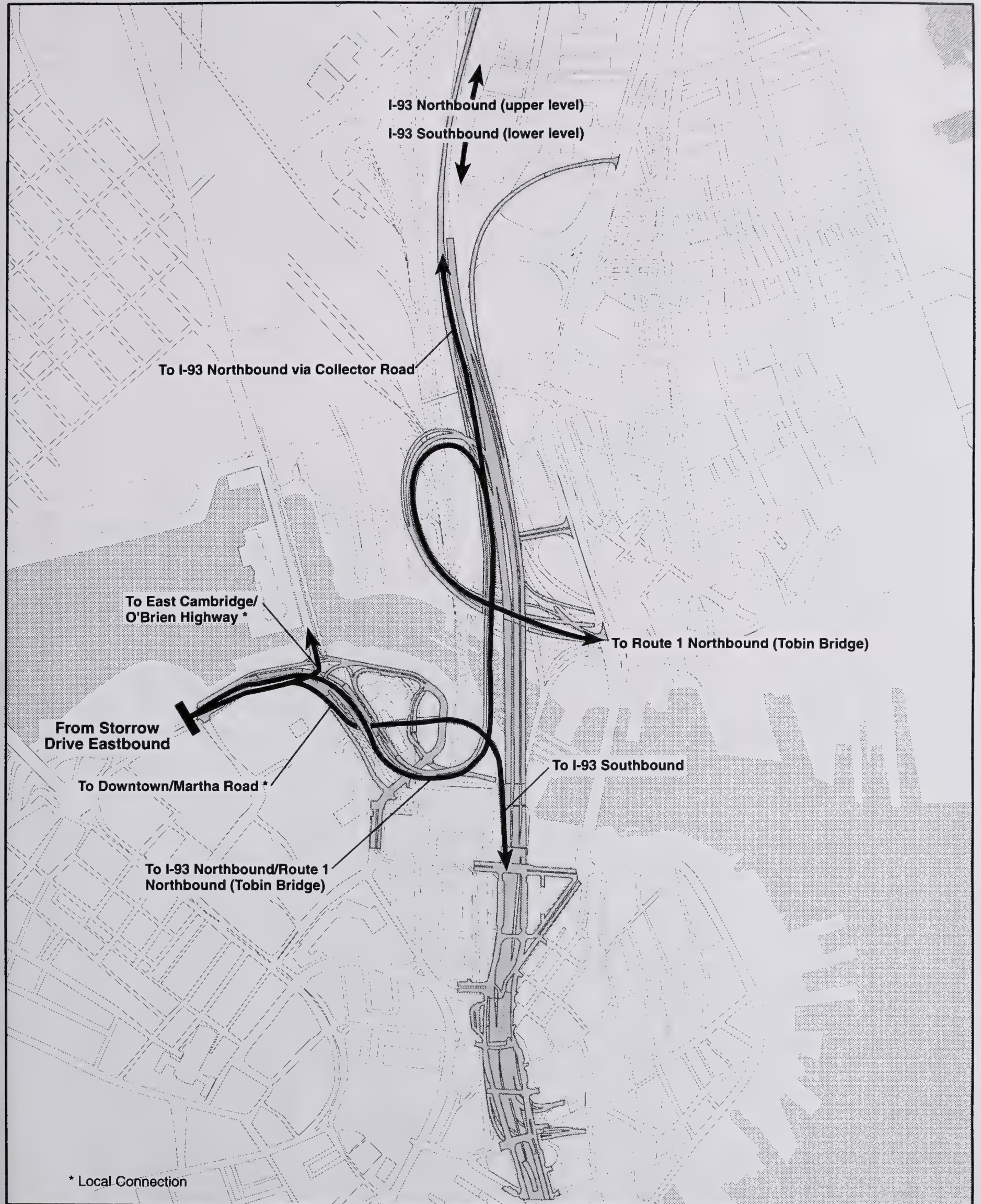
2.20

Travel Routes From I-93 Northbound: Non-River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





FIGURE

2.21

Travel Routes From Storrow Drive Eastbound: Non-River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



Table 2.2

TRAVEL ROUTES FROM I-93 NORTHBOUND TO SIX DESTINATIONS

Destination	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
I-93 northbound	Continue across 5-lane river bridge	Continue across 4-lane river bridge	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Storrow Drive westbound	Continue north across 5-lane river bridge to 2-lane loop ramp on viaduct to separate 3-lane river bridge (south) to viaduct behind North Station, to existing Leverett Circle underpass	Exit mainline to tunnel behind North Station to transition section behind Registry, bear right to existing Leverett Circle underpass	Same as 8.1D Mod 5	Same as 8.1D Mod 5 except continue straight to existing Leverett Circle underpass
Route 1 northbound	Continue across 5-lane river bridge to 2-lane loop ramp on viaduct transitioning to CANA tunnel under City Square to Tobin Bridge	Exit mainline to tunnel behind North Station, continue in tunnel under river to CANA tunnel under City Square to Tobin Bridge	Continue across 4-lane river bridge to 2-lane loop ramp on viaduct to CANA tunnel under City Square to Tobin Bridge	Same as Reduced River-Tunnel
Rutherford Avenue	Continue across 5-lane river bridge to 2-lane loop ramp on viaduct to surface road at City Square	Continue on 4-lane river bridge to exit ramp behind Bunker Hill Community College (BHCC)	Exit mainline to 2-lane ramp across river bridge to exit ramp behind BHCC	Same as Reduced River-Tunnel
Nashua Street	Same as to Storrow Drive westbound except bear right to surface road behind jail, turn right	Same as to Storrow Drive westbound except bear left to surface road, turn right	Same as 8.1D Mod 5	Exit mainline to tunnel behind North Station to transition section in front of Registry building to surface at east side of jail
Leverett Circle	Same as to Nashua Street, except turn left at Nashua Street signal	Same as to Nashua Street, except continue straight	Same as 8.1D Mod 5	Same as to Nashua Street, except turn left at Nashua Street signal

Source: Bechtel/Parsons Brinckerhoff

TRAVEL ROUTES FROM I-93 SOUTHBOUND TO SIX DESTINATIONS

Destination	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
I-93 southbound	Continue across 5-lane river bridge	Continue across 4-lane river bridge	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Storrow Drive westbound	Single lane exit north of Gilmore Bridge to 1-lane ramp to 3-lane double-deck bridge across river to viaduct behind North Station to existing Leverett Circle underpass	Two-lane exit at Sullivan Square to lower level of double-decked viaduct, continue under Gilmore Bridge to 1-lane viaduct to 2-lane ramp on river bridge, to viaduct behind North Station to existing Leverett Circle underpass	Same as 8.1D Mod 5	Same as 8.1D Mod 5, except river crossing is on separate bridge
Route 1 northbound	Exit north of Gilmore Bridge to 2-lane loop ramp and transition to CANA tunnel under City Square to Tobin Bridge	Exit at Sullivan Square to lower level of double-decked viaduct to surface road under Gilmore Bridge through at-grade signalized intersection to CANA tunnel	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Rutherford Avenue	Same as above except to transition to surface at City Square	Same as above except turn left at signalized intersection	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Nashua Street	Same as to Storrow Drive westbound except bear right to surface road behind jail, turn right	Same as to Storrow Drive westbound except bear right to surface road behind jail, turn right	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Leverett Circle	Same as above except turn left at Nashua Street signal	Same as above except turn left at Nashua Street signal	Same as 8.1D Mod 5	Same as 8.1D Mod 5

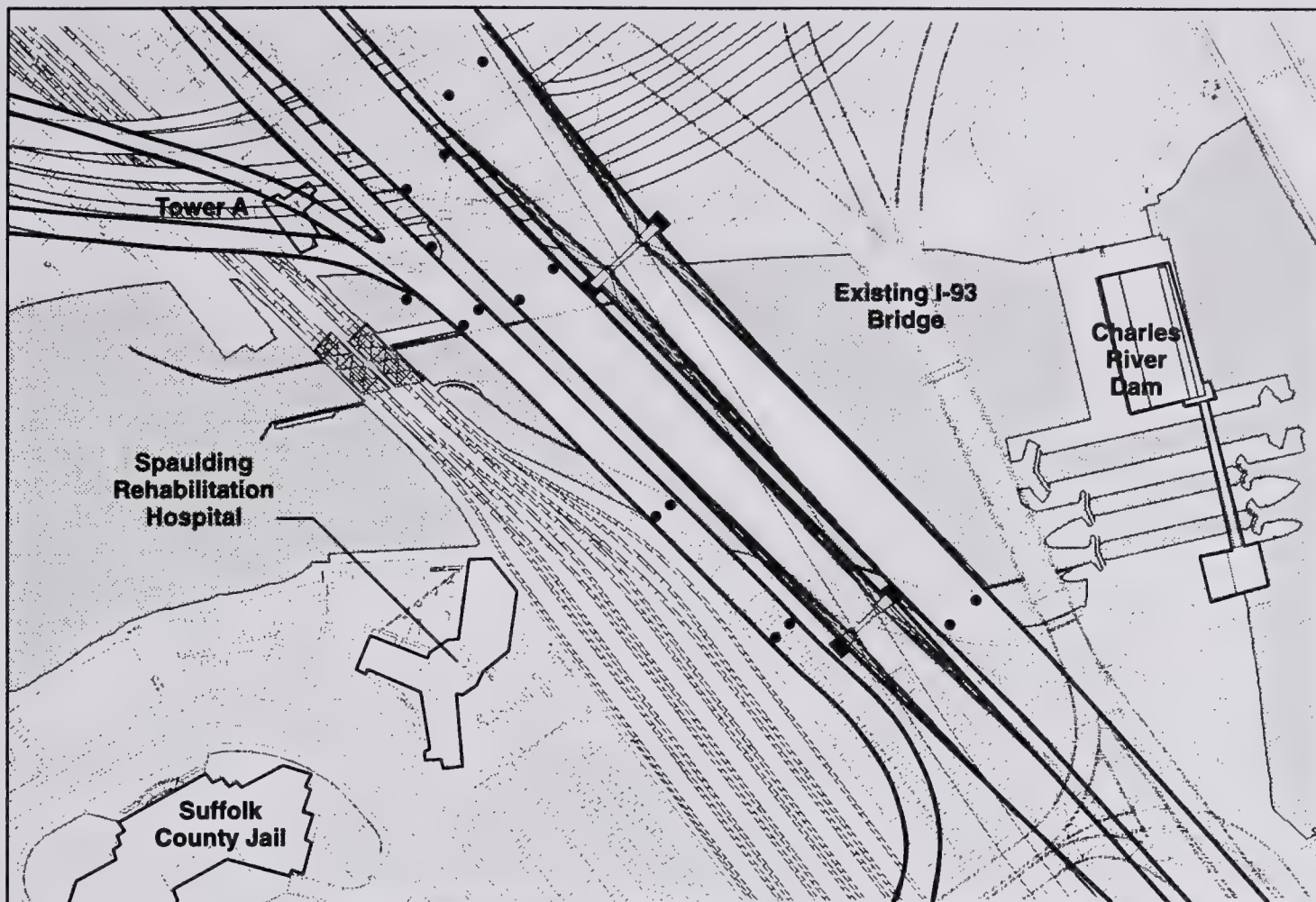
TRAVEL ROUTES FROM ROUTE 1 SOUTHBOUND TO SIX DESTINATIONS

Destination	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
I-93 southbound	Exit CANA tunnel to 2-lane loop ramp viaduct to 5-lane river bridge southbound	Exit CANA tunnel to 3-lane loop ramp viaduct to 4-lane river bridge southbound	Same as 8.1D Mod 5 except to 2-lane loop ramp viaduct	Same as Reduced River-Tunnel
I-93 northbound	Exit CANA tunnel to ramp viaduct merging with I-93 at Gilmore Bridge	Exit CANA tunnel through signalized intersection; continue under Gilmore Bridge to upper level of a double-decked viaduct which joins I-93 at Sullivan Square	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Storrow Drive westbound	Exit CANA tunnel to loop ramp viaduct to double-decked river bridge to viaduct behind North Station, bear left to existing Leverett Circle underpass	Exit CANA tunnel to 3-lane loop ramp viaduct to 2-lane ramp on river bridge, to viaduct behind North Station, bear right to existing Leverett Circle underpass	Same as 8.1D Mod 5 except to 2-lane loop ramp viaduct	Same as Reduced River-Tunnel except river crossing is on separate bridge
Rutherford Avenue	Exit CANA tunnel to transition section to signalized intersection	Exit CANA tunnel to at-grade signalized intersection, turn right	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Nashua Street	Same as to Storrow Drive westbound except bear right to surface road behind jail, turn right	Same as to Storrow Drive westbound, except bear right to surface road behind jail, turn right	Same as 8.1D Mod 5 except to 2-lane loop ramp viaduct	Same as Reduced River-Tunnel except river crossing is on separate bridge
Leverett Circle	Same as to Nashua Street, except turn left at Nashua Street signal	Same as to Nashua Street except turn left at Nashua Street signal	Same as 8.1D Mod 5 except 2-lane loop ramp viaduct	Same as Reduced River-Tunnel except river crossing is on separate bridge

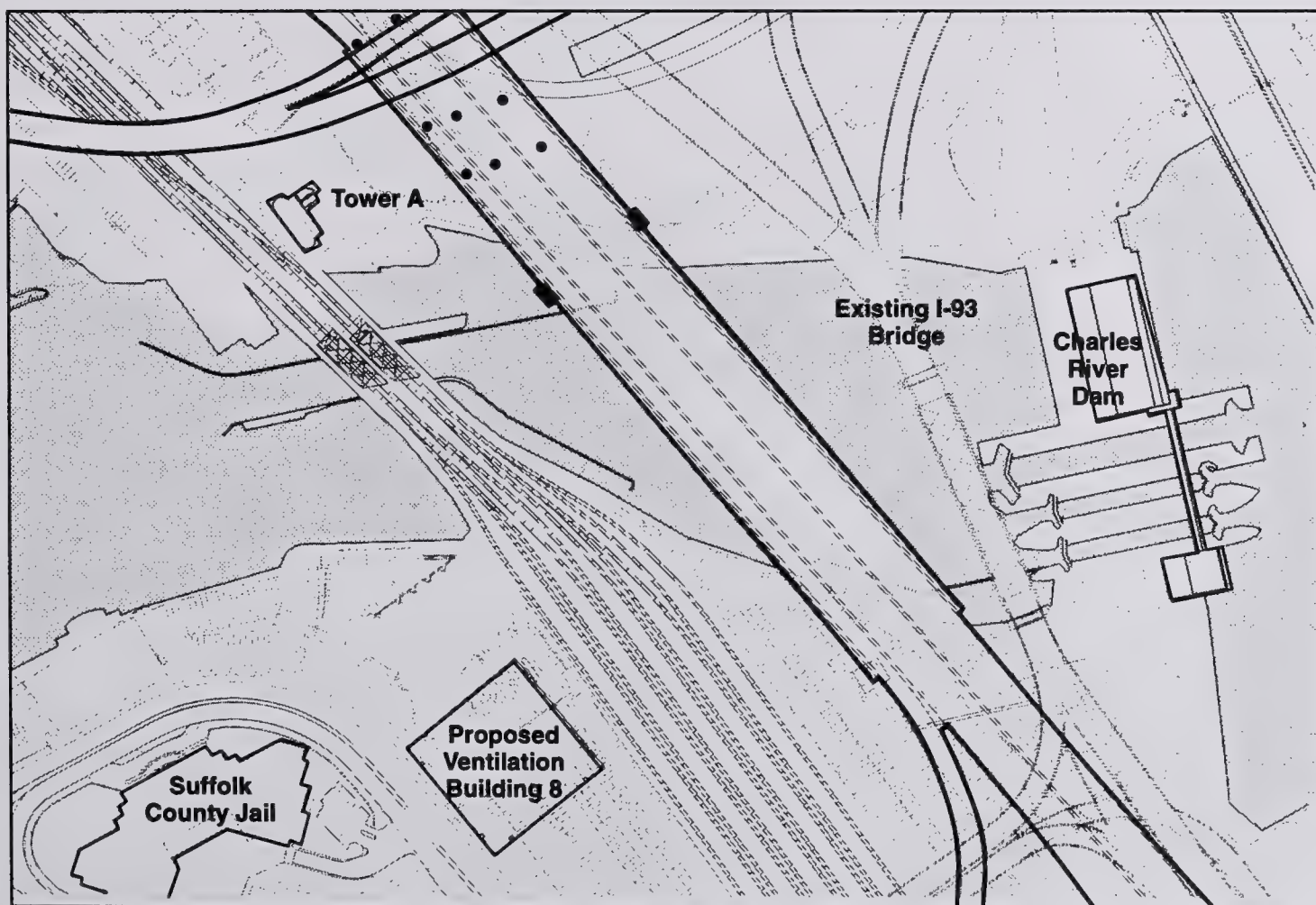
TRAVEL ROUTES FROM STORROW DRIVE EASTBOUND TO SIX DESTINATIONS

Destination	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
I-93 southbound	Continue through 2-lane Leverett Circle underpass to upper level of double-decked viaduct behind North Station, north to separate double-decked river bridge to loop ramp to 5-lane river bridge (south)	Continue on surface to transition section east of Leverett Circle to tunnel under North Station to 5-lane tunnel	Same as 8.1D Mod 5	Same as 8.1D Mod 5
I-93 northbound	Continue through new 2-lane Leverett Circle underpass to upper level of double-decked viaduct behind North Station, to separate double-decked river bridge to viaduct over Gilmore Bridge	Continue on surface to transition section east of Leverett Circle to loop tunnel beneath North Station area to 3-lane river tunnel to loop tunnel west of Rutherford Avenue to surface road under Gilmore Bridge to upper level of double-decked viaduct to Sullivan Square	Continue into tunnel under Leverett Circle to 2-lane river tunnel to tunnel west of Rutherford Avenue to surface road under Gilmore Bridge to upper deck of double-deck viaduct to Sullivan Square	Continue into tunnel under Leverett Circle to viaduct behind North Station to separate river bridge to surface road under Gilmore Bridge to upper level of double-decked viaduct to Sullivan Square
Route 1 northbound	Continue through new 2-lane eastbound Leverett Circle underpass to upper level of double-decked viaduct behind North Station, to separate double-decked river bridge to loop ramp to CANA tunnel	Same as to I-93 northbound except to transition section to CANA tunnel	Same as to I-93 northbound except through river tunnel to transition section to CANA tunnel	Same as to I-93 northbound except from separate river bridge to loop ramp viaduct to CANA tunnel
Rutherford Avenue	Continue through new 2-lane eastbound Leverett Circle underpass to upper level of double-decked viaduct behind North Station, to separate double-decked river bridge to loop ramp to City Square	From Leverett Circle turn left to O'Brien Highway to Gilmore Bridge; or, turn right to Martha Road, to Merrimac Street to Causeway Street, to North Washington Street bridge	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Nashua Street	Turn right at Leverett Circle to Martha Road	Same as Scheme Z	Same as Scheme Z	Same as Scheme Z
Leverett Circle	Stay on surface; left to O'Brien Highway, right to Martha Road	Same as Scheme Z	Same as Scheme Z	Same as Scheme Z

Source: Bechtel/Parsons Brinckerhoff



Scheme Z



Alternative 8.1D Mod 5

FIGURE

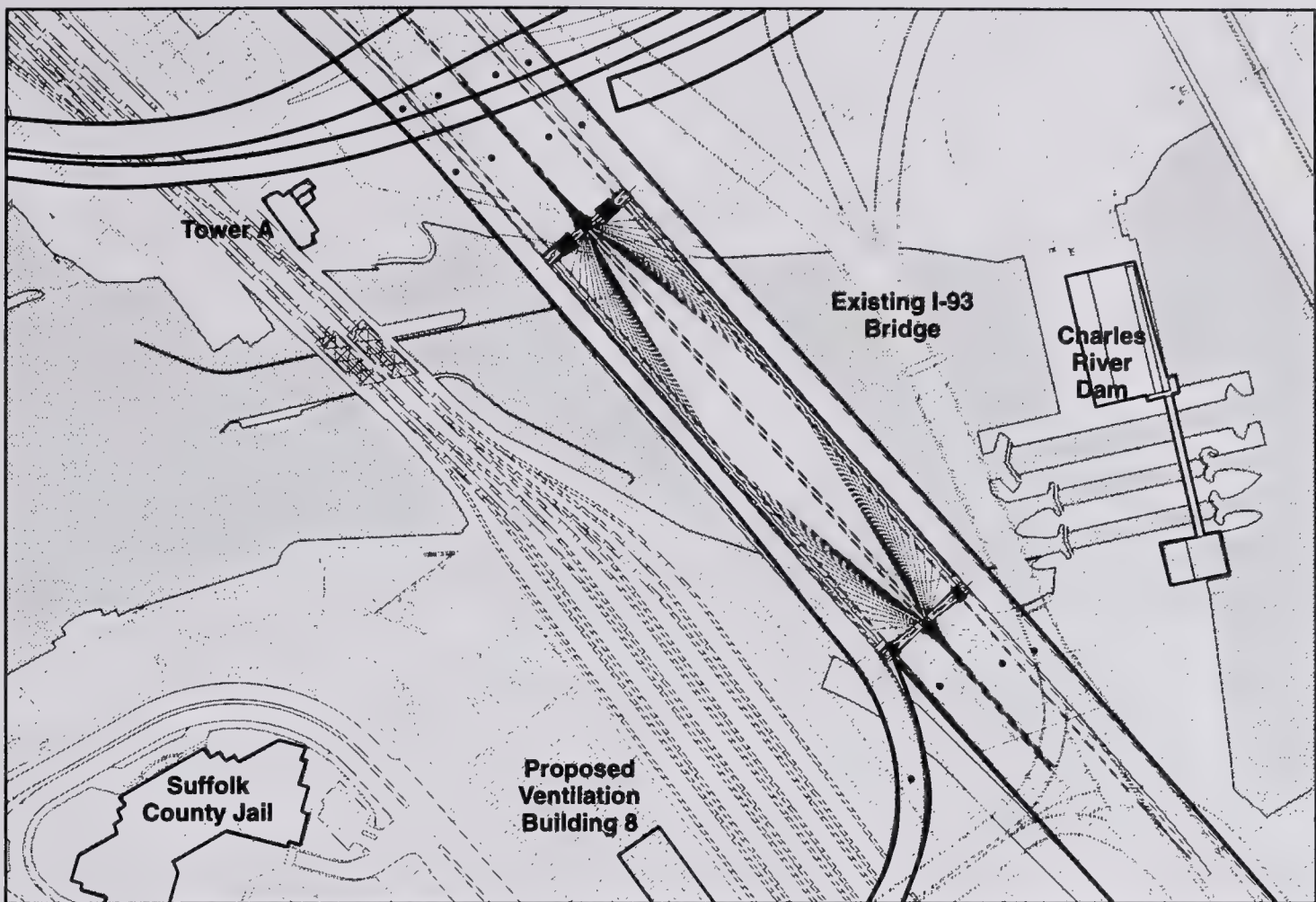
2.22

**Plan Views Of Charles River Bridge:
Scheme Z And Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

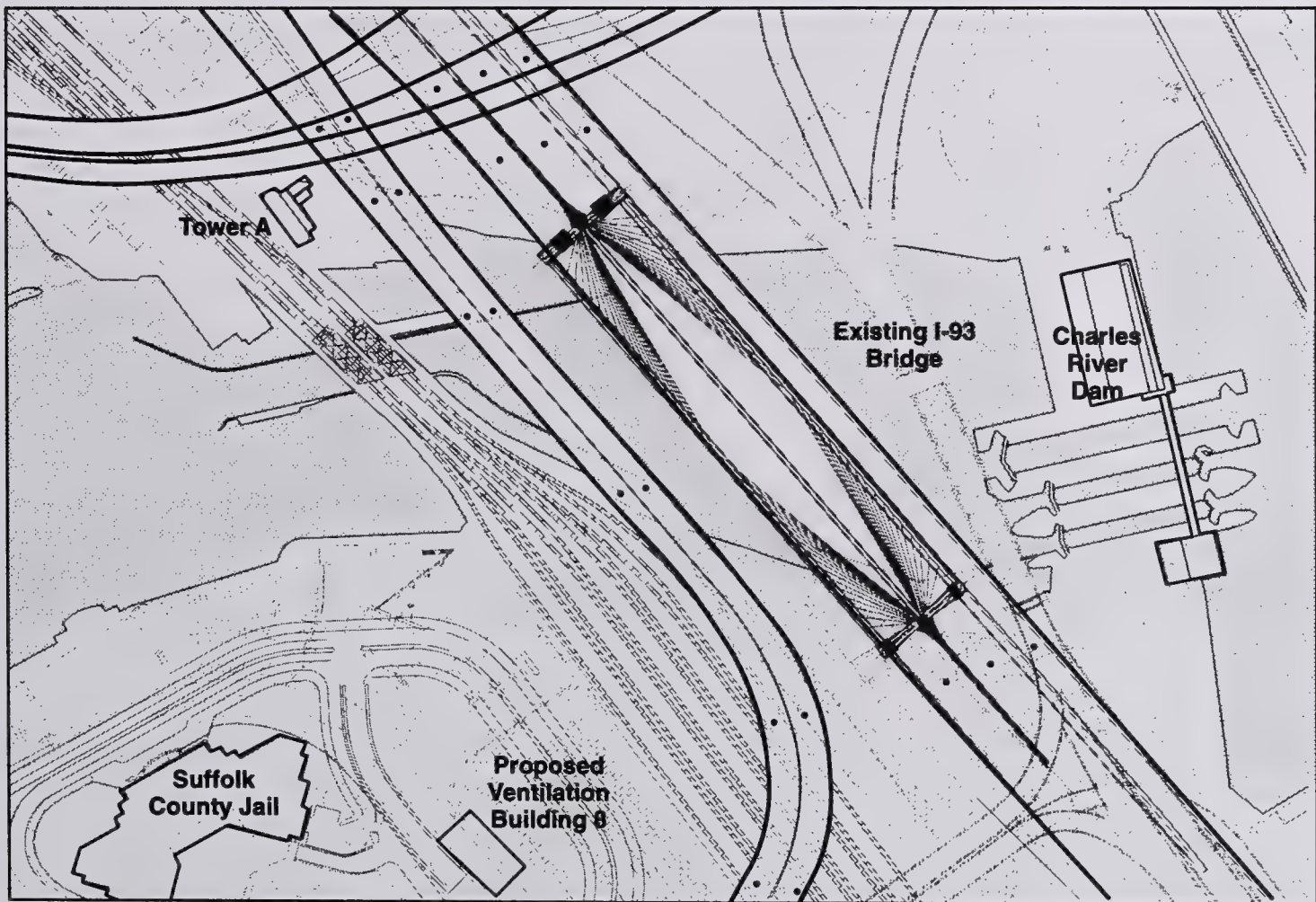
MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 800 FEET





Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

FIGURE

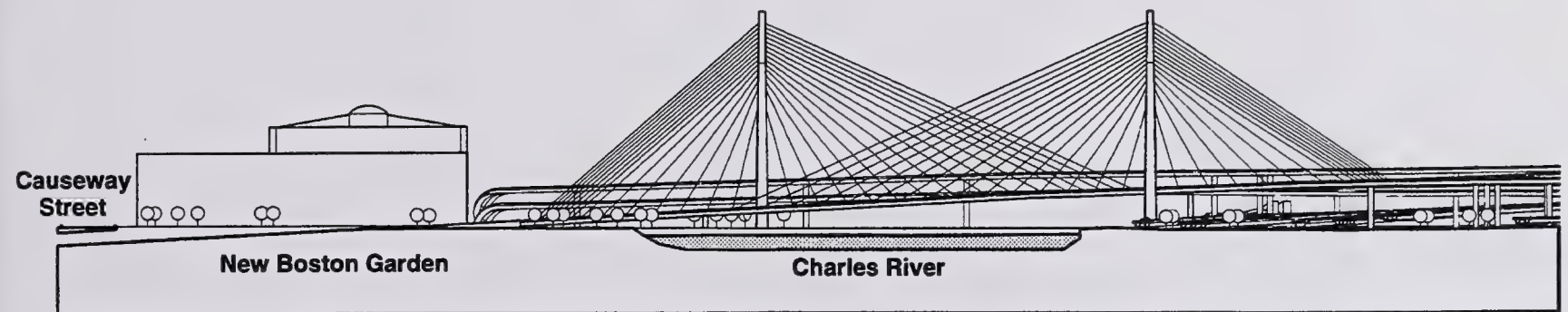
2.23

**Plan Views Of Charles River Bridge:
Reduced River-Tunnel And
Non-River-Tunnel Alternatives**
Charles River Crossing DSEIS/R

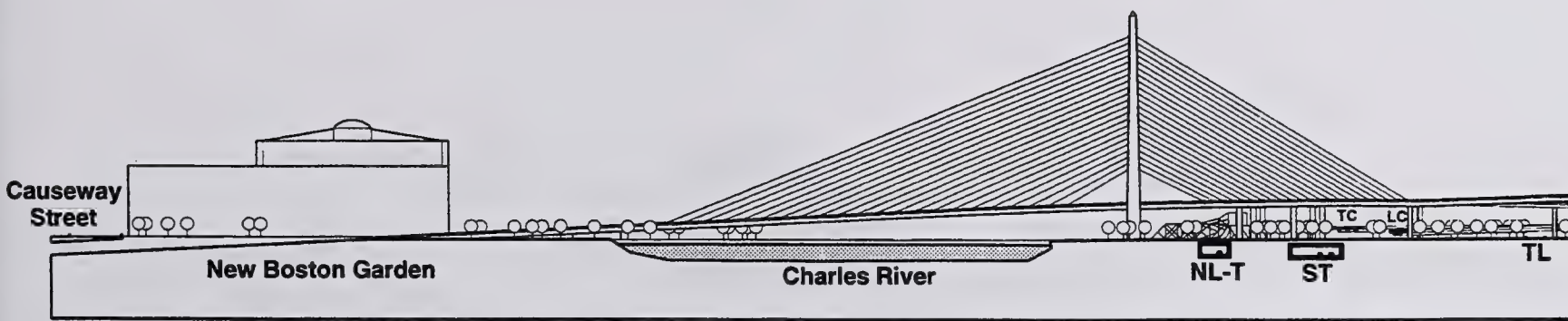
MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 800 FEET

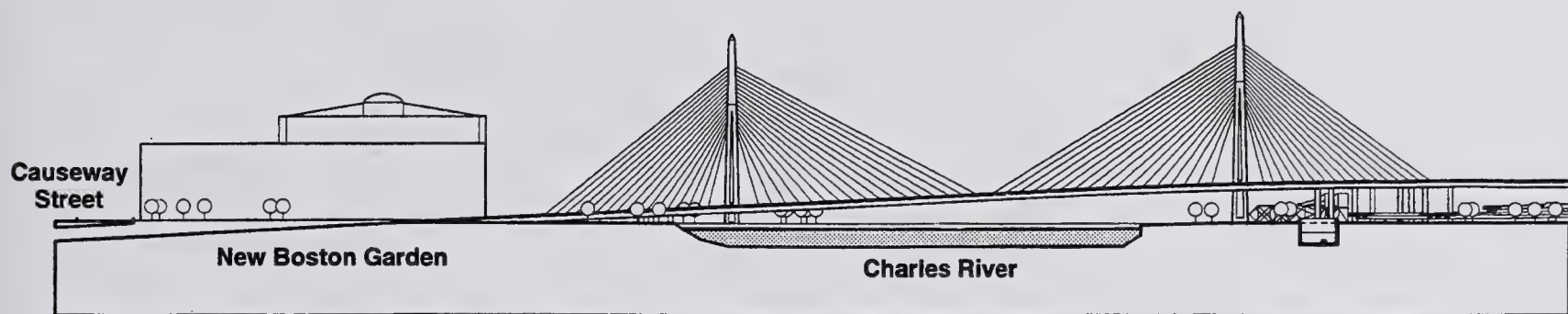




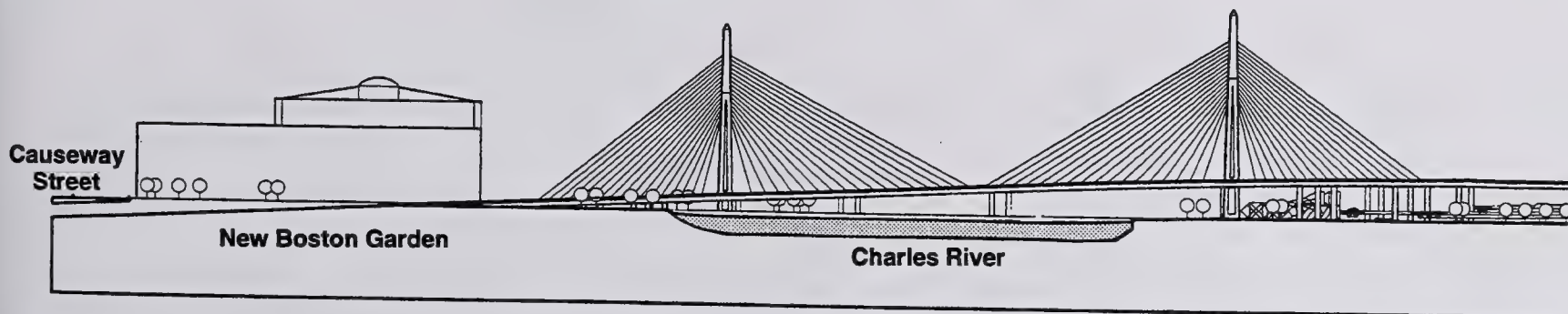
Scheme Z



Alternative 8.1D Mod 5



Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

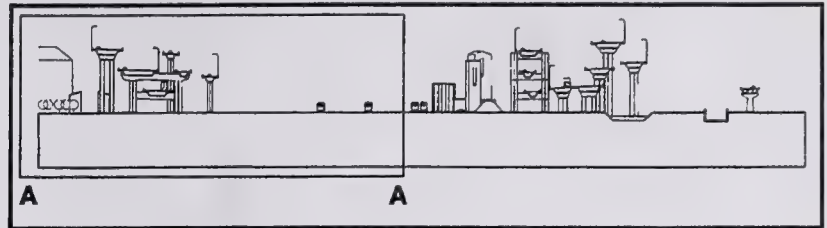
FIGURE

2.25

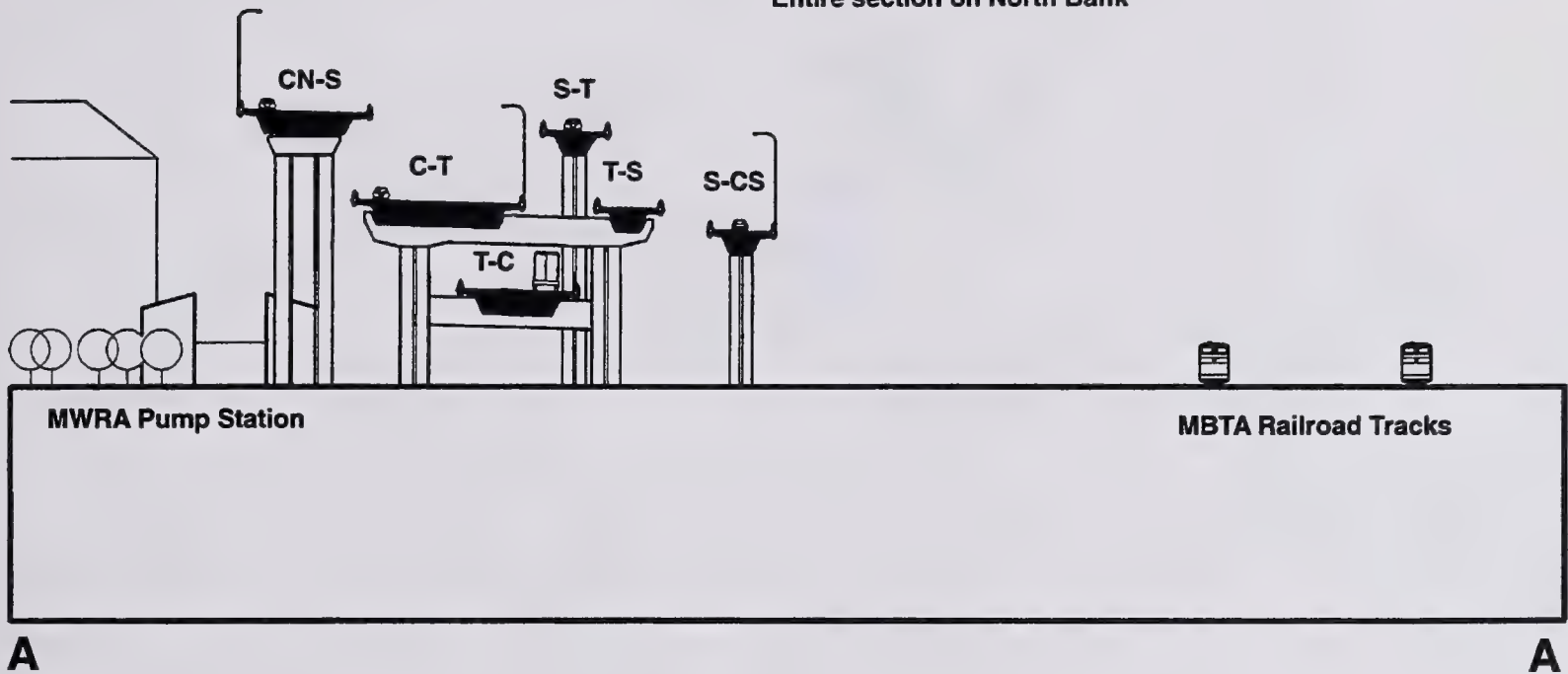
**Elevations Of Charles River Bridge:
Reduced River-Tunnel And Non-River-
Tunnel Alternatives Looking West**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

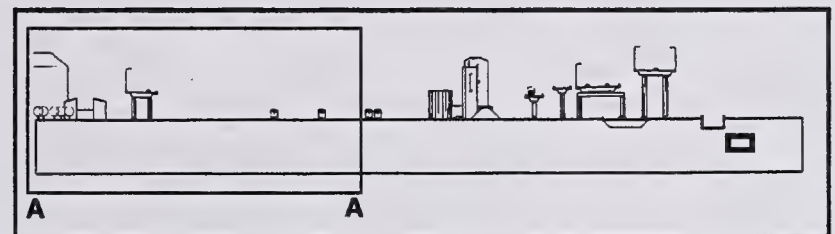




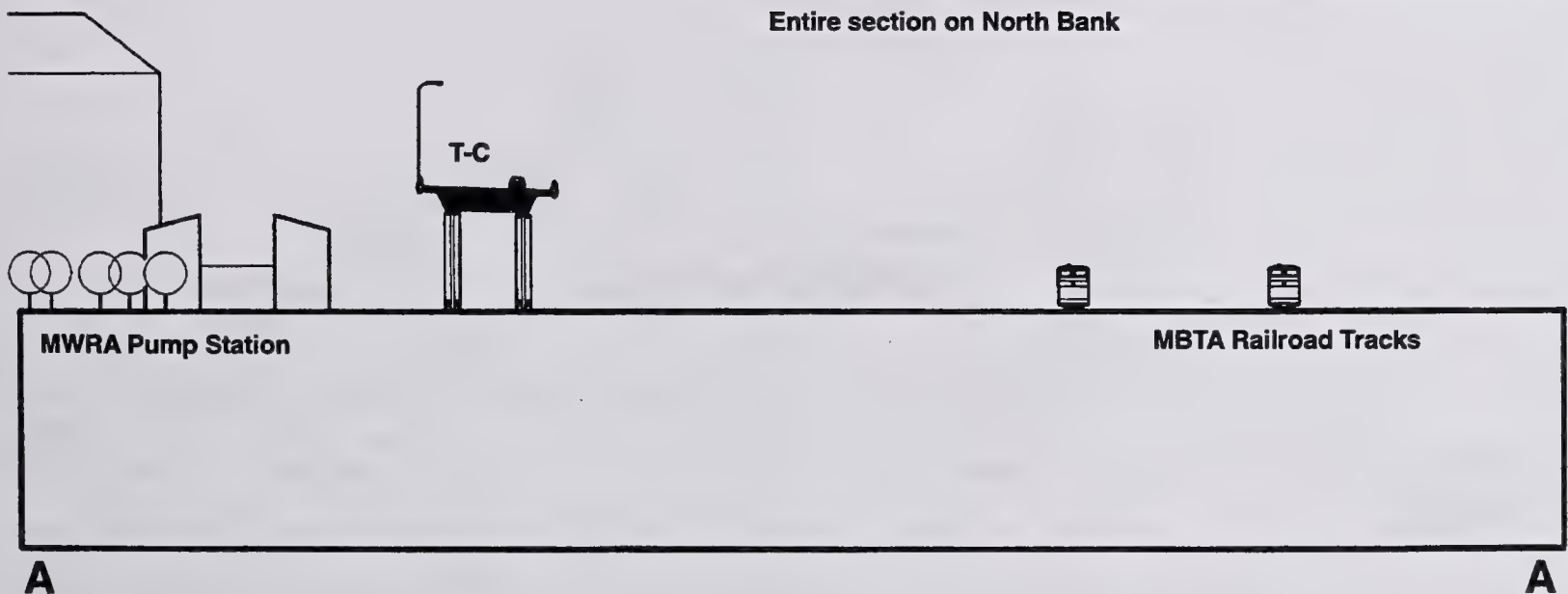
Entire section on North Bank



Scheme Z



Entire section on North Bank



Alternative 8.1D Mod 5

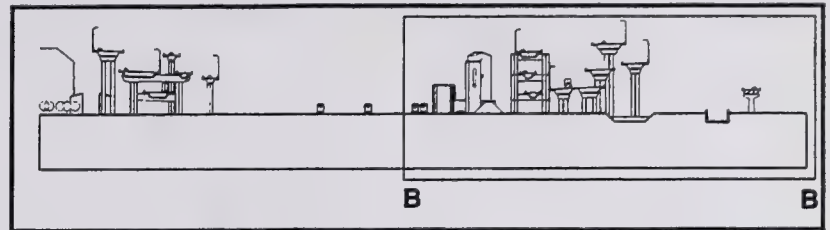
FIGURE

2.26

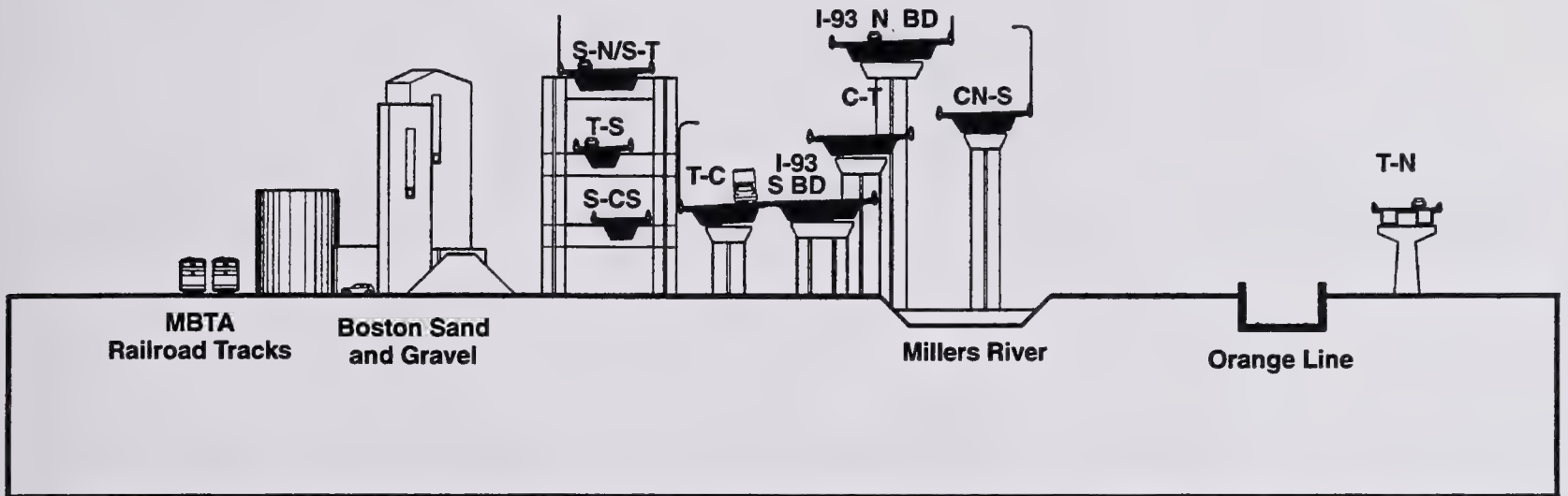
Sections At Loop Ramps On
North Bank: Scheme Z And
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

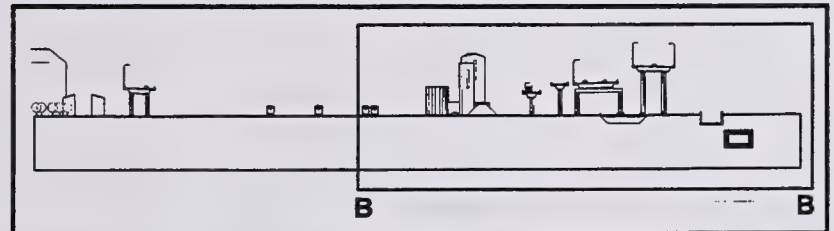




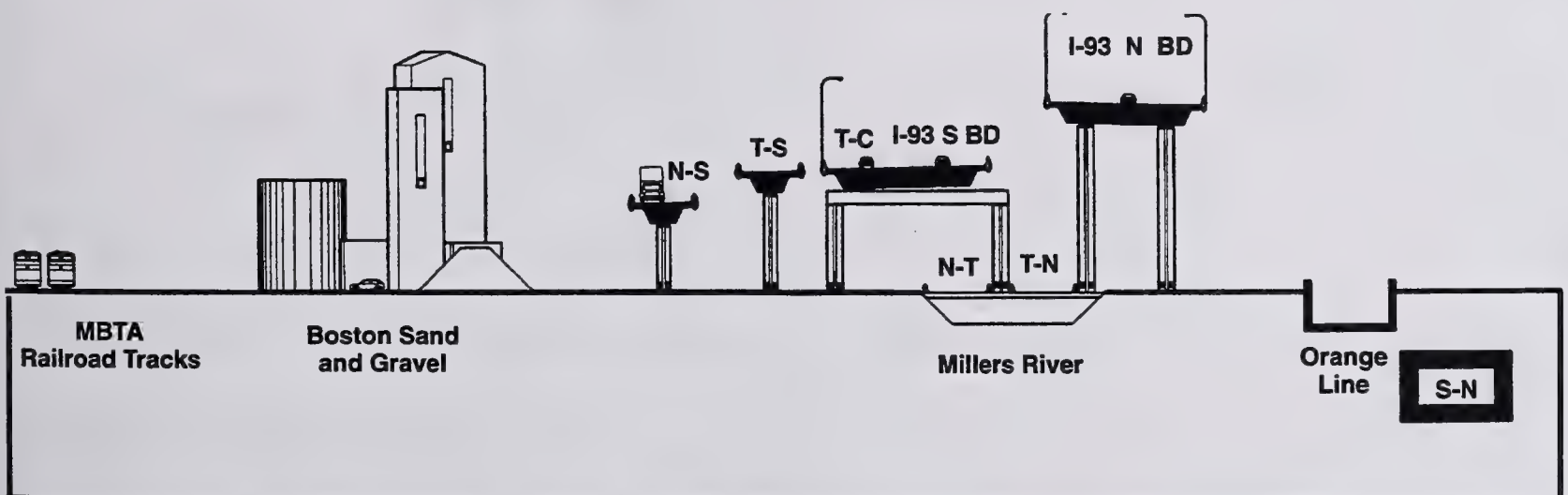
Entire section on North Bank



B
Scheme Z



Entire section on North Bank



B
Alternative 8.1D Mod 5

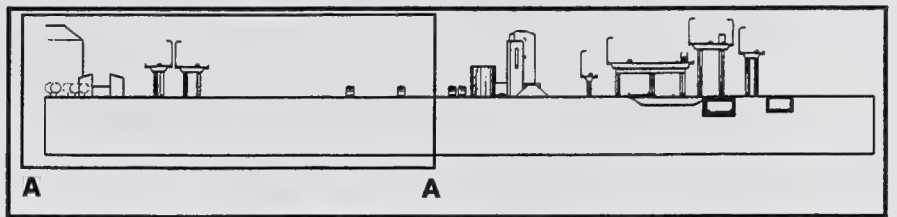
FIGURE

2.27

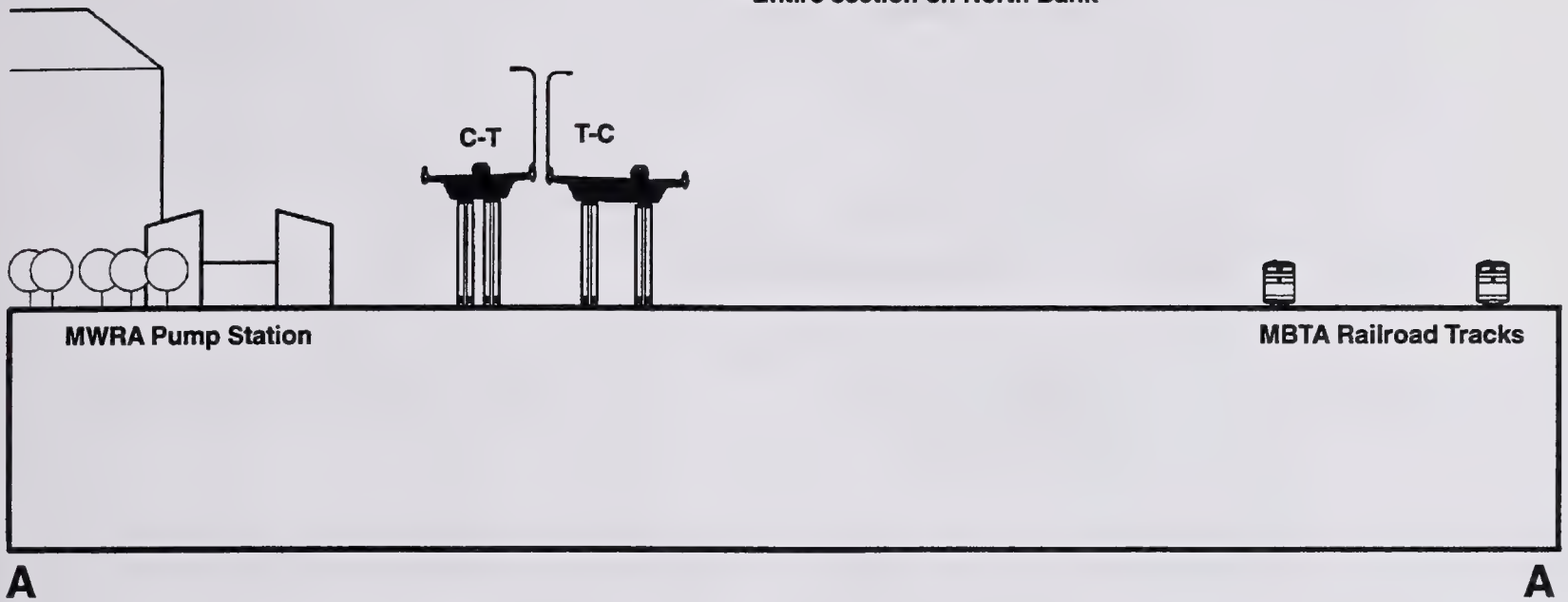
Sections At Loop Ramps On
North Bank: Scheme Z And
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

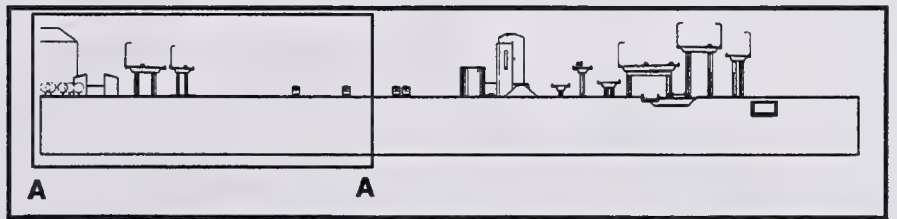




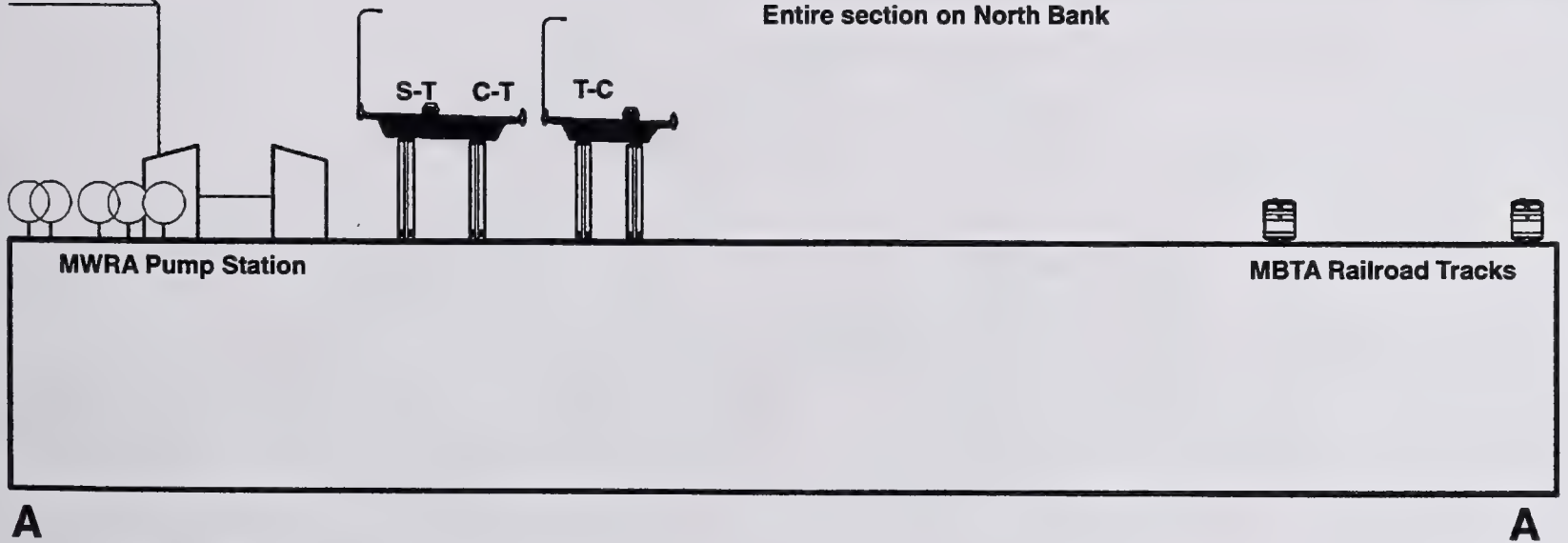
Entire section on North Bank



Reduced River-Tunnel Alternative



Entire section on North Bank



Non-River-Tunnel Alternative

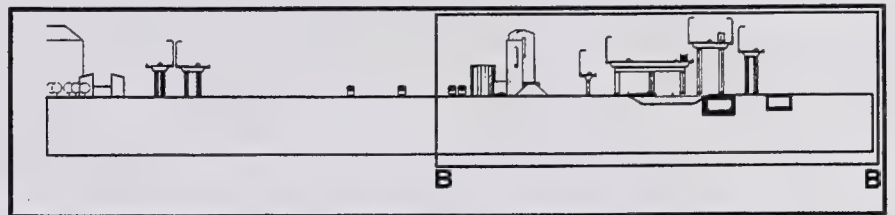
FIGURE

2.28

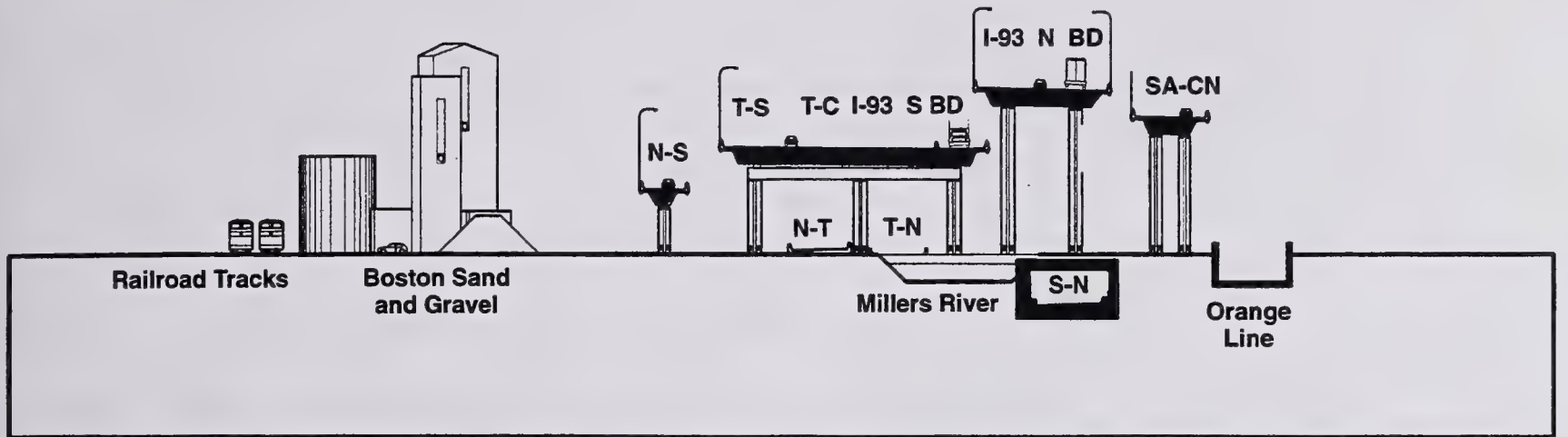
Sections At Loop Ramps On
North Bank: Reduced River-Tunnel
And Non-River-Tunnel Alternatives
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

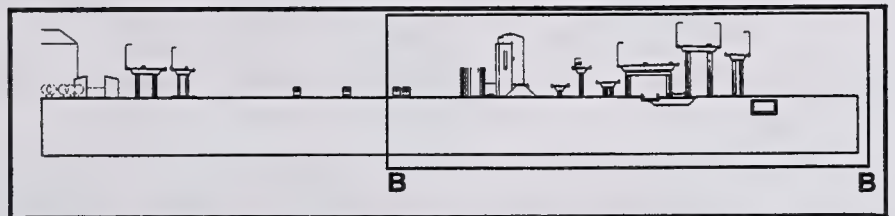




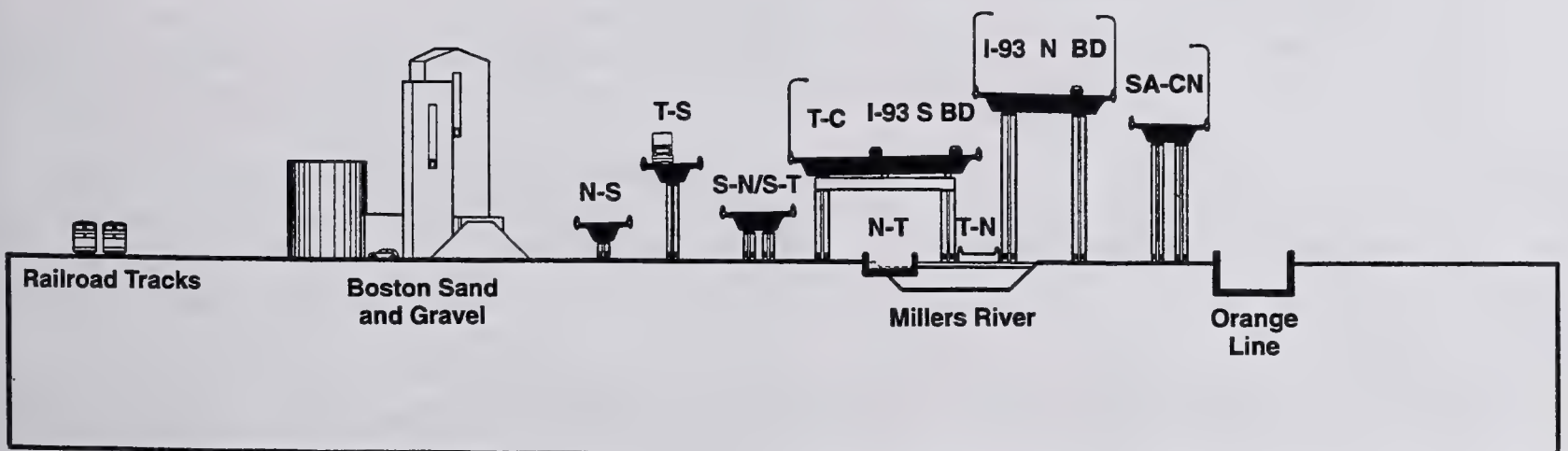
Entire section on North Bank



B
Reduced River-Tunnel Alternative



Entire section on North Bank



B
Non-River-Tunnel Alternative

FIGURE

2.29

Sections At Loop Ramps On
North Bank: Reduced River-Tunnel
And Non-River-Tunnel Alternatives
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



2.6 DESIGN REFINEMENTS TO ALTERNATIVES

As part of its ongoing effort to adhere to the directive of the 1991 MEPA Certificate to "reduce the environmental and aesthetic impacts of the Charles River crossing", MHD has continued to meet with the executive committee of the BDRC, the Boston Transportation Department (BTD), and concerned citizen groups to review and evaluate suggestions for further refinements of the three new design alternatives. These proposed refinements are described in this section and are currently under study. In the event that any design refinement is incorporated into the appropriate alternative, the results of the evaluation of any environmental impacts of that refinement will be included in the FSEIS/R. The refinements described below do not appear to involve major new environmental impacts; nor do they substantially alter the conceptual framework of any alternative. New impacts to historic structures resulting from the refinements are identified below.

2.6.1 Alternative 8.1D Mod 5: Design Refinements

2.6.1(a) Single Ventilation Building Versus Two Ventilation Buildings

Alternative 8.1D Mod 5 as it appears in the NPC has a single ventilation building located on the south side of the Charles River. During subsequent design development it was determined that a two ventilation building design would be more prudent. The second structure would be located on the north side of the Charles River adjacent to Boston Sand & Gravel. A two-ventilation building design as described in Section 2.4 for the Reduced River-Tunnel Alternative could be equally applied to Alternative 8.1D Mod 5.

2.6.1(b) Bridge Structures

A value engineering study conducted for the area suggested consideration of a fin-back type bridge structure. This bridge design will be considered with the proposed cable-stay and other long-span structures during the bridge type study following selection of the preferred alternative.

The bridge structure identified in Alternative 8.1D Mod 5 is a single twin-legged tower cable-stayed bridge carrying ten lanes of traffic. During subsequent conceptual design development a two tower cable-stayed bridge was introduced which is characterized by lower overall tower height and diamond shaped towers carrying eight lanes between the tower legs and an additional two lanes cantilevered on the outside of the towers. This conceptual design could be applied to any proposed ten lane bridge crossing and is identified in Section 2.6.3 Non-River-Tunnel Alternative. In addition, a twelve lane version of this design is identified in Section 2.6.2, Reduced River-Tunnel Alternative.

2.6.1(c) Redesign Of Leverett Circle/Nashua Street Area

A refinement has been suggested to Alternative 8.1D Mod 5 involving a redesign of the Leverett Circle/Nashua Street area, which addresses its traffic operations and those at the nearby Lowell Square area (see Figure 2.30).

The Ramp S-N/L-N (Storrow/local-to-north) traffic movements would be realigned to use a common access ramp for both movements. Traffic from Storrow Drive would proceed straight through Leverett Circle to a new signalized intersection along Nashua Street. Local traffic from downtown destined for points north would also proceed to this intersection. A new two-lane ramp would originate at this point, continue under the Registry building (100 Nashua Street), and turn northerly around the Suffolk County Jail. At this point the tunnel would rejoin the Alternative 8.1D Mod 5 Ramp C-T alignment and would pass under the Charles River as a three-lane river tunnel.

This suggested refinement would eliminate the tightly curved tunnel geometry for Ramp L-N in the Leverett Circle area. An eastbound underpass for Storrow Drive traffic destined for points south would be incorporated in an attempt to improve traffic operations at Leverett Circle. Ramp M-N at the Lowell Square area would also be eliminated, thereby improving traffic operations. The Ramp N-L (north-to-local) traffic would access Nashua Street via the above-mentioned new intersection.

This design would slightly reduce overall material disposal requirements due to the reduction of tunnel. This design refinement, however, would require the demolition of the Registry building, a building eligible for inclusion on the National Register of Historic Places.

2.6.2 Reduced River-Tunnel Alternative: Design Refinements

2.6.2(a) Realignment Of the River Tunnel

This suggested design refinement to the Reduced River-Tunnel Alternative involves a realignment of the river tunnel. The S-T (Storrow-to-Tobin) and S-N (Storrow-to-I-93 northbound) traffic movements would be accommodated in a manner similar to a tunnel alignment previously considered and rejected by the BDRC known as 8.1D Mod 3. This alignment would pass under the Charles River just west of the existing MBTA bascule railroad bridge. The elimination of the Ramp C-T tunnel connection from 8.1D Mod 3 (this traffic would be accommodated on the mainline viaduct and a second loop ramp), improves the feasibility of the alignment. The geometry of the river tunnel alignment, and its connection to the Tobin Bridge would still, however, remain substandard for a ramp connector.

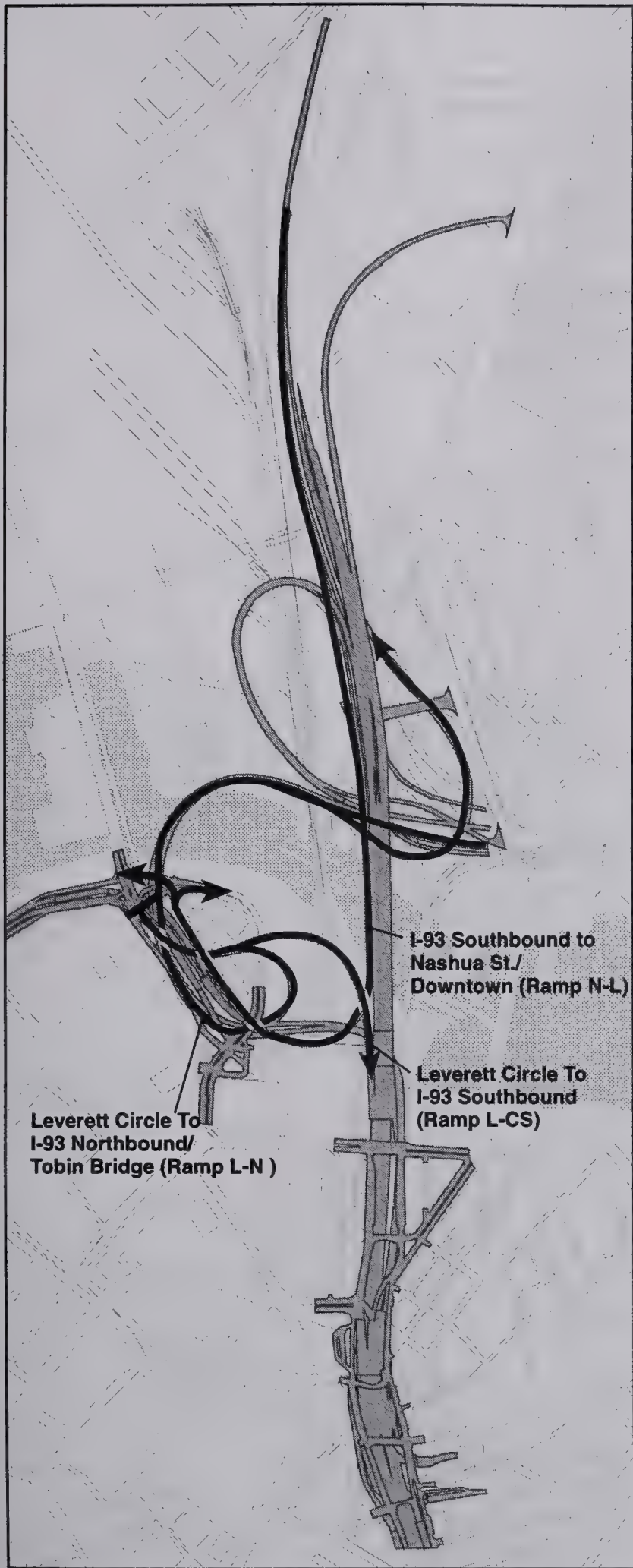
Further refinements to the proposal suggested above have been proposed to improve geometrics (see Figure 2.31). The river tunnel alignment would be located in the existing transportation corridor between the MBTA bascule railroad bridge and the existing I-93 high level truss bridge. Concerns that previously focused on the constructibility of a tunnel in this alignment still remain to be addressed, including compatibility with the proposed North Station/South Station rail link. North of the Charles River the alignment would be improved somewhat by placing the Ramp S-N tunnel in approximately the same corridor as in the Reduced River-Tunnel Alternative. The connection to the Tobin Bridge would be accommodated by Ramp S-T which would diverge left from Ramp S-N after it passes under the Service Road. Ramp S-T would then rise to pass over the MBTA commuter railroad tracks and subsequently would join Ramp C-T as in the Non-River-Tunnel Alternative.

2.6.2(b) Redesign Of Leverett Circle/Nashua Street Area

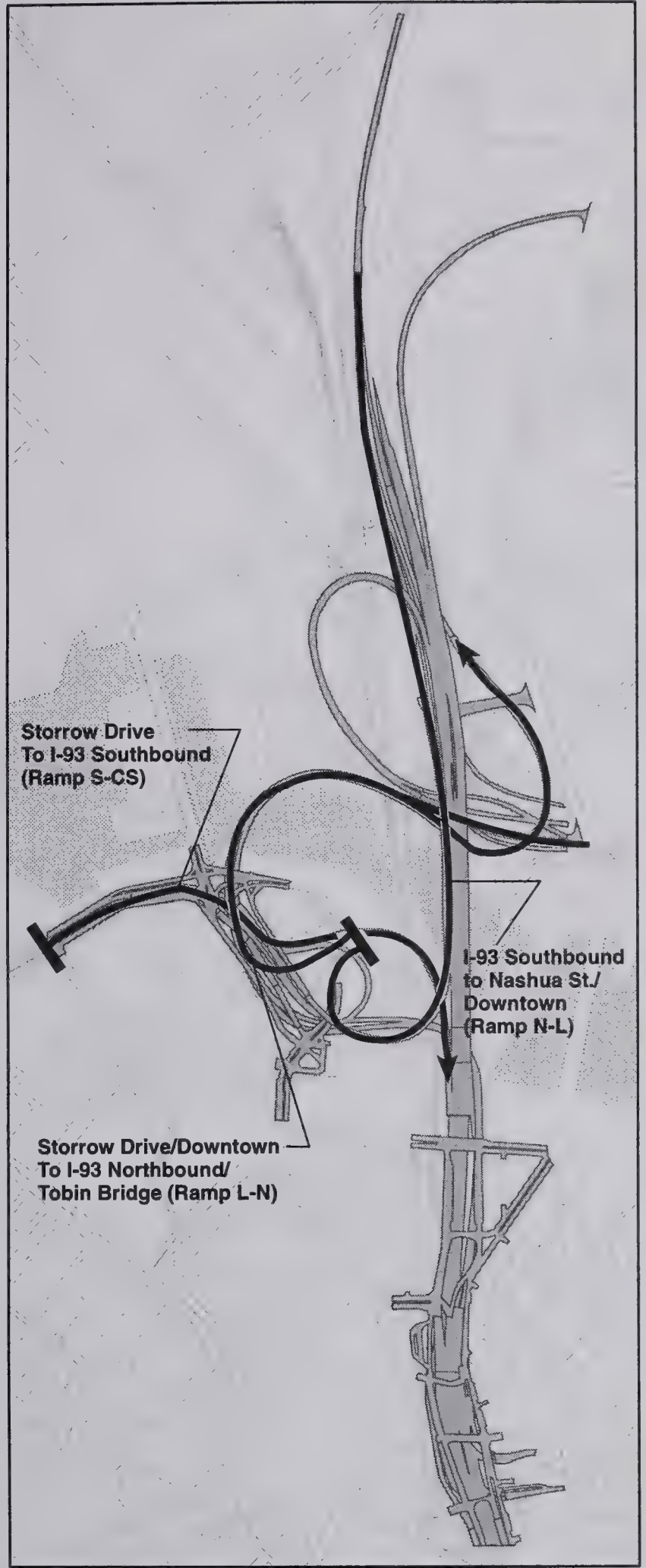
The refinement discussed in Subsection 2.6.1(c) which involves a redesign of the Leverett Circle/Nashua Street area, and addresses its traffic operations and those at the nearby Lowell Square area can also be applied to the Reduced River-Tunnel Alternative with the following exception. Ramp C-T traffic would use the I-93 mainline bridge to cross the Charles River with the resulting connection to the Tobin Bridge accommodated via a second viaduct loop ramp in East Cambridge.

The Ramp S-N/M-N (Storrow/Merrimac-to-north) traffic movements would be realigned to use a common access ramp for both movements. Eastbound Storrow Drive traffic would proceed along the surface through Leverett Circle to a new signalized intersection along Nashua Street. Local traffic from downtown destined for points north would also proceed to this intersection. A new two-lane ramp would originate at this point and, in an alignment similar to Alternative 8.1D Mod 5, continue under the Charles River to connect to the Tobin Bridge.

An eastbound underpass for Storrow Drive traffic destined for points south would be incorporated into this refinement. Ramp M-N at the Lowell Square area would be eliminated, thereby improving traffic



Alternative 8.1D Mod 5



Design Refinement 2.6.1(c)

FIGURE

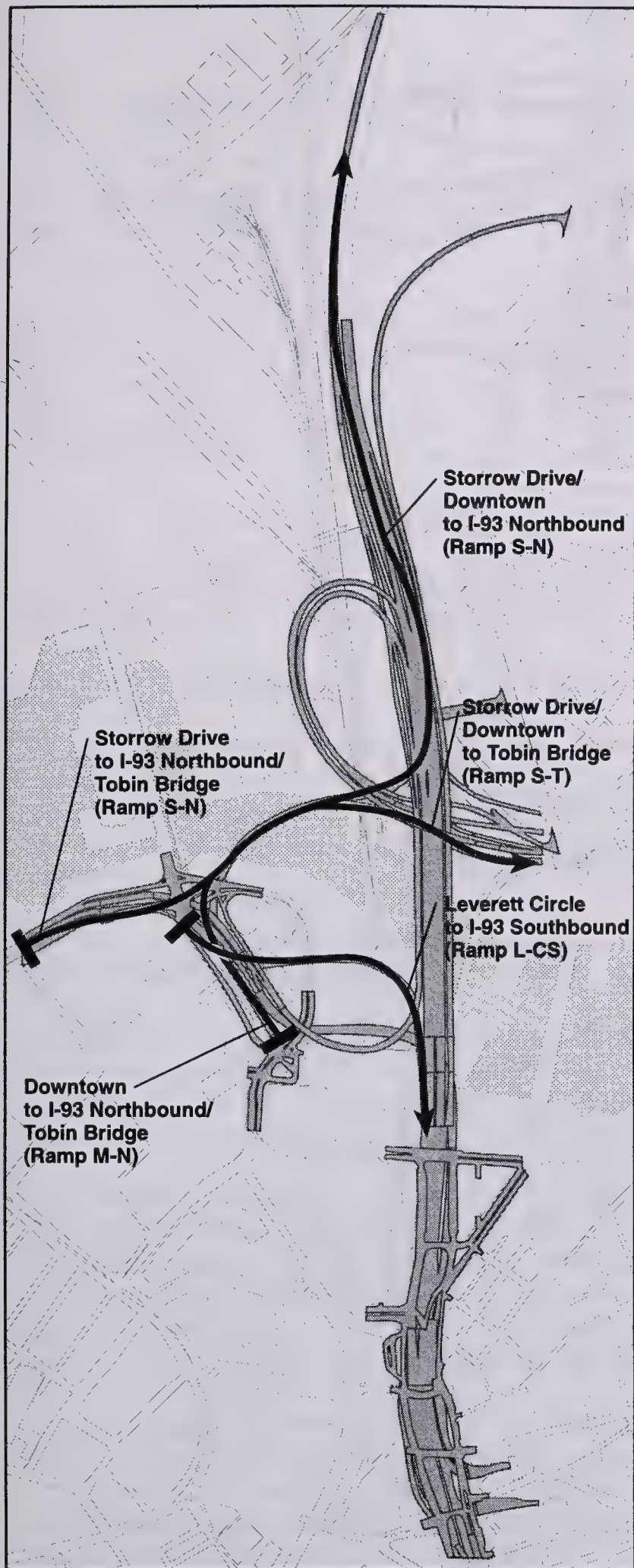
2.30

**Comparison Of
Alternative 8.1D Mod 5
To Design Refinement 2.6.1(c)**
Charles River Crossing DSEIS/R

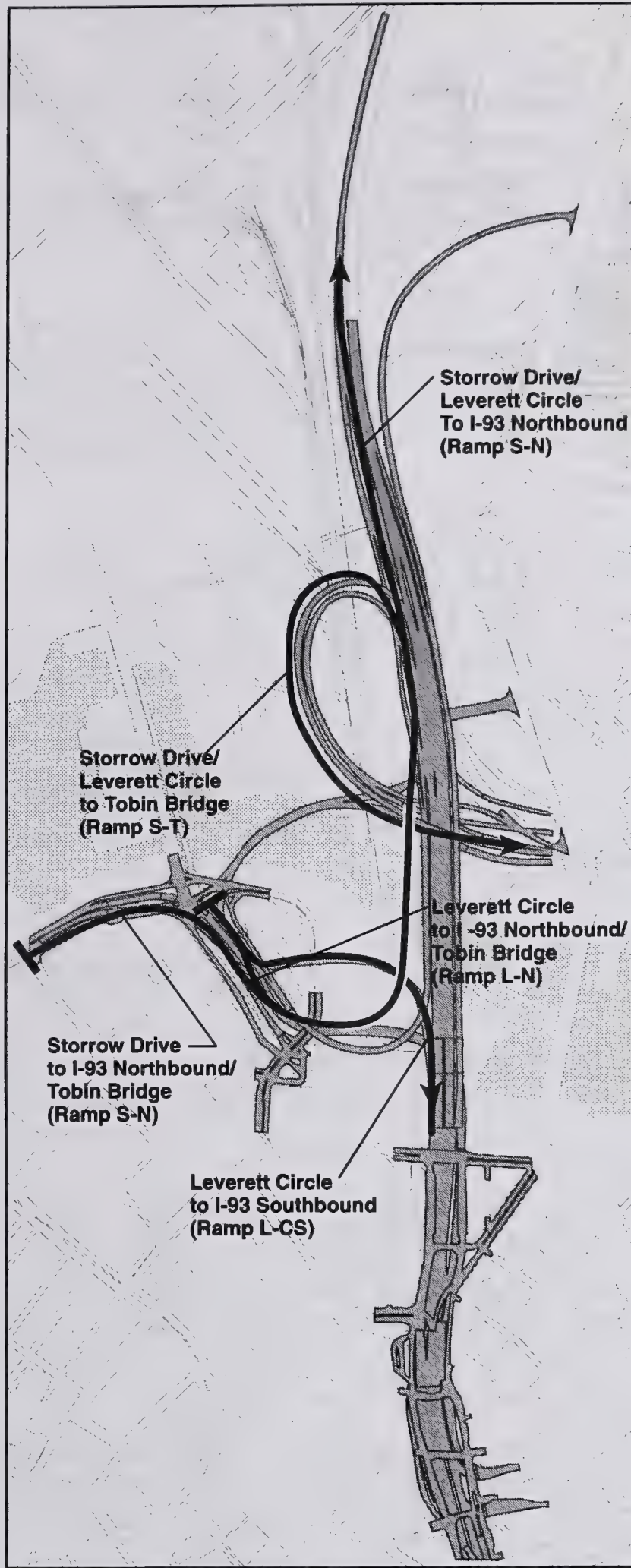
MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





Reduced River-Tunnel Alternative



Design Refinement 2.6.2(b)

FIGURE

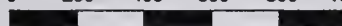
2.31

Comparison Of Reduced River-Tunnel Alternative To Design Refinement 2.6.2(b)

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



operations. Ramp N-L (north-to-local) traffic would access Nashua Street via the above-mentioned new intersection.

As in the proposal for Alternative 8.1D Mod 5, this design refinement would require the demolition of 100 Nashua Street, the Registry, a building eligible for inclusion on the National Register of Historic Places.

2.6.2(c) I-93 Northbound Right-Hand Exit

A plan to alter the I-93 northbound mainline to five lanes instead of the four lane plus two lane configuration under this alternative has been proposed. This requires a right-hand off-ramp from I-93 to a ramp connector northbound to the Tobin Bridge. The purpose of the design refinement is to improve the aesthetics of the river crossing and reduce impacts to Paul Revere Landing Park South.

2.6.2(d) Two-Way River Tunnel

The proposal to construct a two-way river tunnel was rejected during the BDRC process (CIP 5). In view of concerns already expressed about the environmental impacts of extensive tunneling in the Charles River, this proposal is not being studied further.

2.6.3 Non-River-Tunnel Alternative: Design Refinements

2.6.3(a) Realignment Of Storrow To North Traffic Movements

The design refinement for the Reduced River-Tunnel Alternative which was identified in Subsection 2.6.2(a) can be applied to the Non-River-Tunnel Alternative except that two traffic movements (Storrow-to-I-93/Tobin Bridge) are in tunnel, thereby reducing the bridge structure across the Charles River to twelve lanes.

2.6.3(b) I-93 Northbound Right-Hand Exit

This refinement is similar to that described above in Subsection 2.6.2(c).

2.6.3(c) Realignment Of Ramp CN-L (I-93 Northbound To Nashua Street)

Several variations of the I-93 northbound off ramp to Nashua Street are currently under investigation. This design refinement is being studied to minimize impact to the proposed parkland development parcels along the south bank of the Charles River (see Figure 2.32).

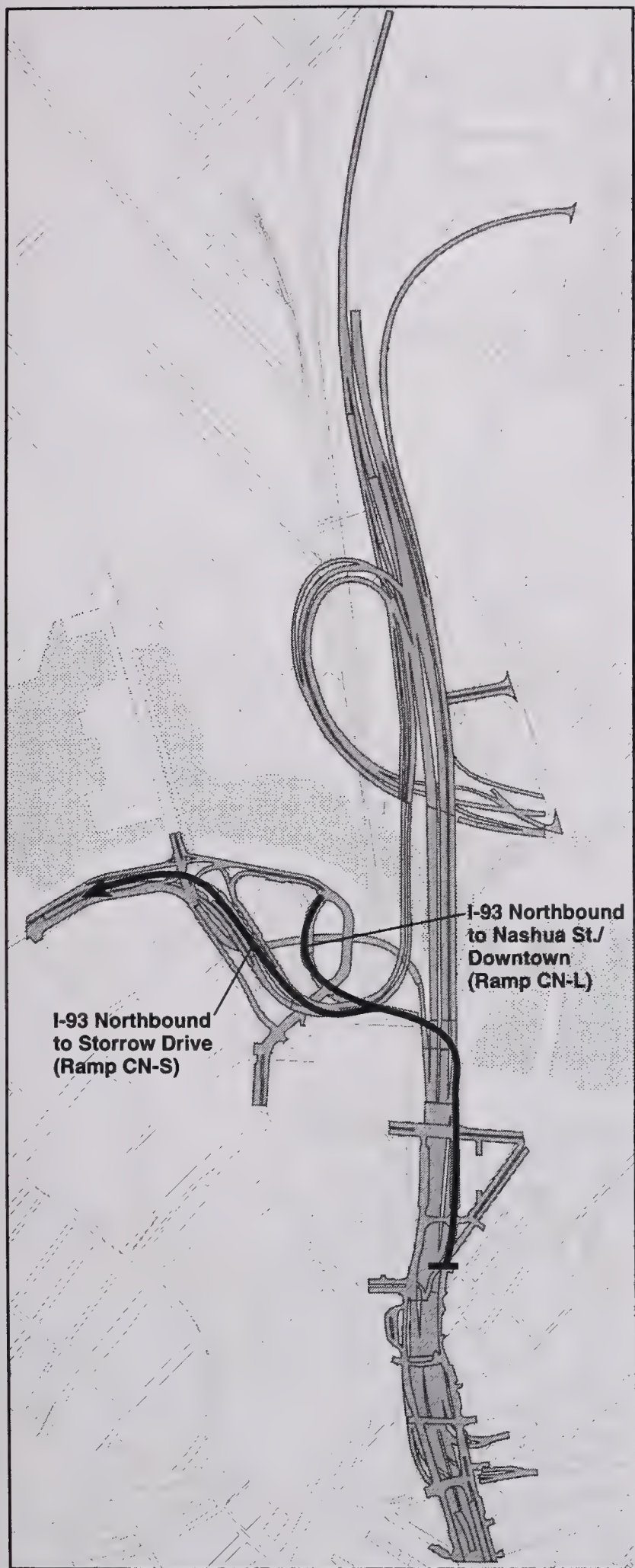
Traffic from I-93 northbound destined for the Nashua Street/North Station area would exit from the connection to Storrow Drive in the vicinity of the MBTA Commuter railroad tracks via a one lane tunnel. This traffic would proceed either 1) parallel to the tracks and meet existing Nashua Street in the vicinity of the Spaulding Rehabilitation Hospital or 2) loop around in front of the Registry building to a relocated Nashua Street with less impact on proposed parkland. Both variations avoid 4(f) impact and result in improved parcel configurations for joint development purposes.

2.6.3(d) Refinements To The New Eastbound Underpass At Leverett Circle

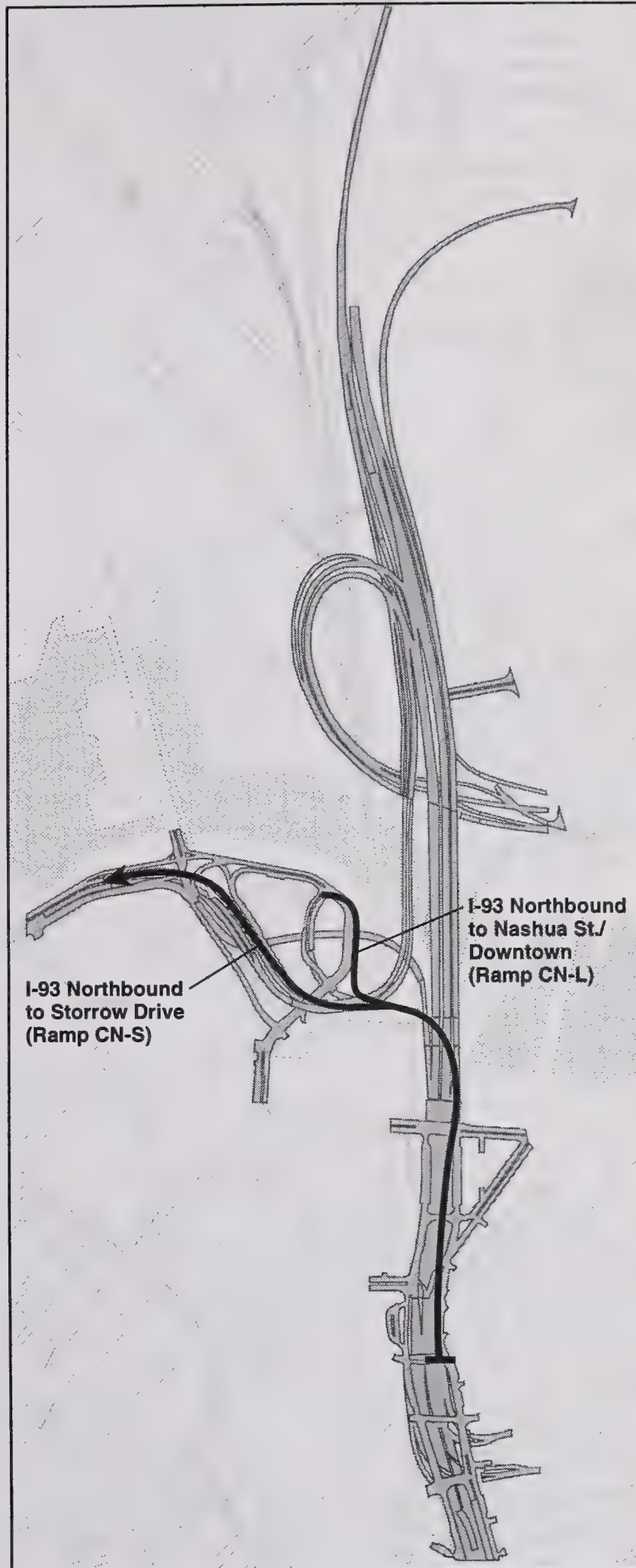
This refinement realigns the transition section of the new eastbound underpass along Storrow Drive to avoid unnecessary encroachment to Storrow Drive and to the Charles River Park apartments. Variations include shortening the underpass, reconstructing a new two-way underpass, and minimizing the width of the surface road approach at Leverett Circle.

2.6.3(e) Ramp C-T In Tunnel

This proposed refinement places the outside loop ramp (Ramp C-T) in East Cambridge in a tunnel under the MBTA commuter railroad tracks and may be possible with a right-hand off-ramp for the C-T traffic. Several conceptual alignments of this proposal have been developed previously during the BDRC process.



Non-River-Tunnel Alternative



Design Refinement 2.6.3(c)

FIGURE

2.32

**Comparison Of
Non-River-Tunnel Alternative
To Design Refinement 2.6.3(c)**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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3. Affected Environment

Chapter 3

AFFECTED ENVIRONMENT

This chapter provides a concise description of the social, economic, and environmental setting in the Area North of Causeway Street, the Project subarea affected by Scheme Z and the three new design alternatives presented in this DSEIS/R. Also described are proposed developments by others in this subarea. The subarea is the northernmost of the I-93 portion of the Central Artery/Tunnel Project (see Figure 3.1). It is bounded on the south by Causeway Street, on the north by the Sullivan Square area (south of Cambridge Street) in the eastern Somerville/Charlestown border area, on the west by Blossom Street at Storrow Drive, and on the east by the North Washington Street bridge, connecting Keaney Square in Boston with City Square in Charlestown. The subarea is extended northerly for this DSEIS/R from the Gilmore Bridge area in East Cambridge/Charlestown to include the proposed extension of the existing I-93 southbound HOV lane and the I-93 northbound off-ramp to Rutherford Avenue past Bunker Hill Community College. The majority of the subarea is in the City of Boston (Suffolk County), while smaller portions are in Cambridge and Somerville (Middlesex County).

Chapters 4 and 5 of this document discuss the long-term environmental consequences and the short-term, temporary construction period impacts, respectively, of Scheme Z and the three new design alternatives. More specific information on the affected environment is described in those chapters to enable readers to compare impacts directly with existing conditions.

3.1 GENERAL DESCRIPTION OF SUBAREA

The Area North of Causeway Street has been developed over several decades as a major transportation and industrial corridor. The area has also attracted a variety of commercial and institutional uses, including the Boston Garden/North Station, Spaulding Rehabilitation Hospital, Suffolk County Jail, MDC parklands, and other facilities. The transportation corridor, mainly highways (I-93) and railroad tracks, does not contain any residential property. Residential areas are located outside of the transportation corridor in Charlestown, eastern Somerville, East Cambridge, the West End (Charles River Park and Longfellow Towers apartments), Beacon Hill, and the North End. Nonresidential development in the corridor ranges from dense to sparse, and the area continues to be the focus of intense redevelopment interests, particularly on underused parcels. The Charles River bisects the area, flowing west to east to Boston Harbor. It drains from the Charles River Basin through the lower basin between the old MDC dam at O'Brien Highway and the new Charles River dam and locks located between the existing I-93 high-level bridge and the North Washington Street bridge. The Millers River flows from the north into the Charles River via two culverts in this area. Approximately 27,000 vessels (mostly pleasure boats) passed through the upper and lower Charles River dam and locks in 1992, with the highest use during the summer (8,000 vessels in July). The competing recreation, navigation, and development interests and the potential opportunities presented by the planned transportation infrastructure improvements in this confined area have generated land use planning studies by the cities of Boston and Cambridge, as well as a parkland master planning study by the Metropolitan District Commission (MDC). Further information about land use characteristics are in Section 4.2 of this report.

3.1.1 Neighborhoods And Districts

The Area North of Causeway Street includes and abuts five distinct districts or neighborhoods. The Project alignment generally bisects the area in a north/south direction. South of the Charles River is the North Station area, flanked on the west by the West End, and on the east by the North End. North of the river are East Cambridge, Charlestown, and farther north, eastern Somerville. Brief description of the primary areas affected by the Project and of any changes since the 1991 FSEIS/R, follows.

North Station. The North Station area includes the immediate area south of Causeway Street. The rehabilitation of buildings in the Bulfinch Triangle for office space is increasing, and a few new office buildings have been completed. The 60-year-old Boston Garden arena with seating for almost 15,000 persons sits atop North Station, which serves Massachusetts Bay Transportation Authority (MBTA) commuter trains to the northern suburbs. Behind the station are the platforms and 10 railroad tracks leading to the 4-track bascule bridge across the Charles River. Across Causeway Street is another MBTA station serving the Orange Line rapid transit below grade and the Green Line light rail transit primarily above Causeway Street.

Other prominent features in the area include the O'Neill Federal Office Building, the Anelex Building (already acquired by MHD for the Project mainline), and the Boston Thermal Energy Corporation's Minot Station steam generating plant. Between North Station and the Charles River is the Spaulding Rehabilitation Hospital, a chronic care/rehabilitation facility, and the historic Registry of Motor Vehicles building at 100 Nashua Street. The Suffolk County Jail and Nashua Street realignment are recently completed projects in this area.

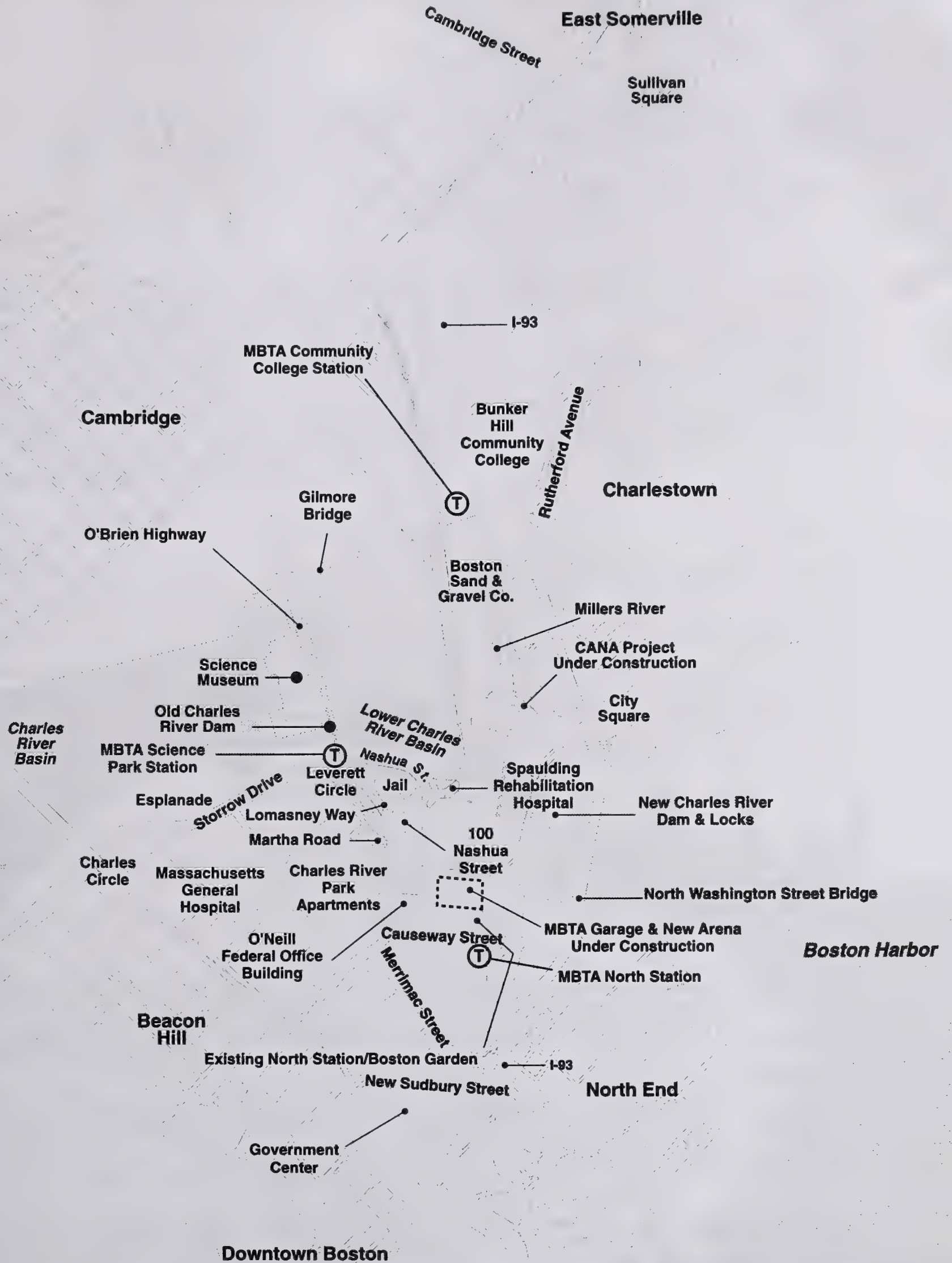
Changes in the North Station area since publication of the FSEIS/R in November 1990 include the following: completion of 101 Merrimac Street, a new 155,000-square-foot (sf) office building; completion of 100 Portland Place, a rehabilitated office building with 100,000 sf; initiation by MBTA of construction of a 1,300-space underground parking garage which includes a portion of the tunnel box for the future relocation of the Green Line; and initiation of construction by the New Boston Garden Development Corporation of a 19,500-seat sports arena above the new MBTA garage.

West End. The primary uses are hospital, medical service, high-density housing (mainly Charles River Park apartments), and retail. Recent development in the area includes substantial additions to Massachusetts General Hospital. Undeveloped land is limited to the remaining urban renewal parcel next to Charles River Park (proposed for housing development). No other new construction has been initiated since the 1991 FSEIS/R in the area closest to the Project alignment.

North End. Although the housing stock once consisted mainly of rental apartments, there are now many new and converted condominium units in the area. Some low-rise, high-rent office space has recently been developed on the south edge of the North End, an area that has become an extension of the waterfront's office/residential/retail orientation.

Housing demand has been strong, with the number of rental units declining as a result of many condominium conversions. This trend has slowed over the last 3 years due to economic conditions. No major new construction has been initiated near the Project limits since the FSEIS/R.

Charlestown. North of the Charles River, the Charlestown Navy Yard continues to be redeveloped for residential and commercial use, and is expected to encourage further development in the surrounding area.



FIGURE

3.1

Affected Environment Existing Conditions

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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The nearly completed CANA (highway) project is expected to stimulate new development on the parcels it has created near City Square and the rehabilitation of existing buildings in the area. The CANA EIS/R designated five development parcels in City Square. During the past few years, the neighborhood has experienced housing rehabilitation and condominium conversion. This trend has decreased recently due to economic conditions. No other new construction has been initiated near the Project area since the FSEIS/R.

Cambridge. The Museum of Science and parking garage is located on filled land along the south side of the O'Brien Highway. The historic Street Railway Viaduct carries the Green Line along the east side of the O'Brien Highway. Further east, the North Point area of East Cambridge is bounded by the Charles River on the south, O'Brien Highway on the west, the Gilmore Bridge to the north, and the Millers River and Charlestown to the northeast. The area comprises primarily industrial, public infrastructure, and transportation uses, including the MWRA Prison Point Pumping Station, railroad track and piggyback yards owned by Guilford Transportation Industries, an MDC maintenance facility, an MHD storage area, and a solid waste transfer station. No new construction has been initiated adjacent to the Project alignment in Cambridge.

3.1.2 Existing Transportation Facilities

The major north-south interstate highway in the area is I-93. In addition, U.S. Route 1 connects with Storrow Drive via an existing high-level double-deck bridge structure that also carries I-93 mainline traffic across the Charles River. There are three complex at-grade interchanges that are critical to moving traffic through the area to local and regional destinations: Leverett Circle in the West End, City Square in Charlestown, and the O'Brien Highway (old Charles River dam)/Gilmore Bridge intersection in Cambridge. In 1979, MHD initiated the CANA project, in Cambridge and Charlestown, in order to improve traffic safety conditions and regional traffic connections. Temporary ramps are scheduled for construction to connect the nearly completed CANA project to the existing Central Artery (I-93). These temporary ramps will be replaced in the future by a permanent connection to the Project's preferred alternative in the Area North of Causeway Street, and they do not affect selection of the preferred alternative.

The existing highway system to be affected by the Project in the Charlestown portion of the subarea consists of a three- to four-lane-wide double-deck viaduct structure with the I-93 northbound lanes stacked over the I-93 southbound lanes. Most of the existing viaduct will be removed and replaced with the new interchange system as part of the Project design from a point south of eastern Somerville to the Charles River.

The existing double-deck I-93 viaduct connects to a double-deck, high-level truss bridge, which crosses over the Charles River from Charlestown into downtown Boston. The bridge has three lanes in each direction. The existing bridge will be removed upon completion of the new bridges and connections as part of the preferred alternative.

At Causeway Street the existing bridge connects to the existing elevated Central Artery with three lanes in each direction. Existing northbound and southbound I-93 lanes connect to Charlestown and Route 1 via elevated ramps on the north bank of the Charles River and to Storrow Drive/Route 1 at Leverett Circle on viaduct behind North Station.

The MBTA operates commuter railroad service to the north and west of Boston through North Station. North of the river is a larger major railroad yard. In addition, the MBTA operates rapid transit service via the Orange Line, with three stations in the affected area, on surface at Sullivan Square and Community College and in subway at North Station. It also operates light rail transit service on the

elevated Green Line with three stations at Lechmere (East Cambridge), Science Park (above Leverett Circle), and North Station. See Section 4.1, Transportation, for more details on transportation facilities in the area.

3.2 PROPOSED PROJECTS

The locations of the proposed projects in the Area North of Causeway Street are shown in Figure 3.2.

Public Projects. The City of Boston's goal for the North Station area, as stated in the Interim Policy Overlay District regulations, is to encourage mixed use development compatible with the adjacent Bulfinch Triangle and North End districts. Its economic development plan for the area north of North Station calls for major high-rise commercial development.

The MBTA plans to upgrade the present commuter railroad service at North Station by extending the 10 railroad tracks and high-level platforms 275 feet south toward the north facade of the existing Boston Garden, by constructing a new Orange Line/Green Line station below grade at North Station, and by replacing the Green Line now on viaduct in the area with a new below-grade alignment behind the Boston Garden and through the edge of the 1,300-space MBTA underground garage now under construction. Also included are foundation supports for future development of an air rights parking garage over the railroad tracks. Farther north, across the Charles River, a new and relocated MBTA Green Line Lechmere station is also planned to serve the East Cambridge area. In addition, the Science Park station will be reconstructed.

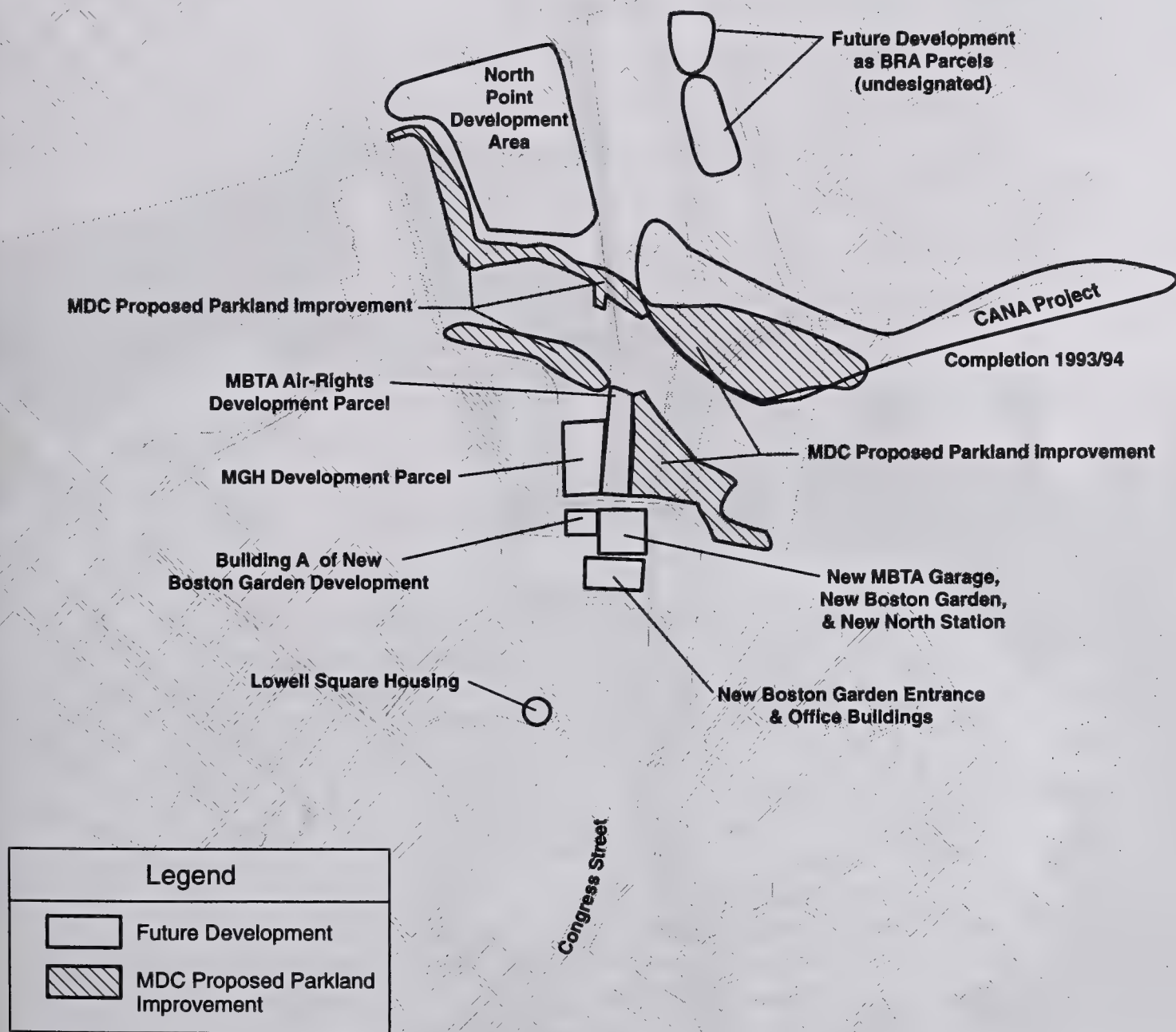
Separate ongoing studies by the Massachusetts EOTC and the Federal Transit Administration (FTA) are exploring the feasibility of linking North and South Stations to provide for through intercity and commuter rail service in the future. Alternative alignments under consideration traverse the Area North of Causeway Street.

Proposed public open space improvements planned by the MDC in the area include the following: a new park located between Nashua Street and the Charles River, a new park on the Cambridge side of the river (on land acquired from the General Services Administration), and extensions of bicycle and pedestrian paths from the Charles River Esplanade to Paul Revere Landing Park on riverside land currently owned by MHD. The goal of the MDC open space master plan for the lower Charles River Basin is to develop continuous open space along the north and south banks of the Charles River between the Esplanade and Boston Harbor.

The North Point area recently has been the focus of a great deal of planning activity by the Cambridge Community Development Department. Plans for the area include redevelopment for mixed residential/commercial use, with an emphasis on housing.

Private Projects. The Massachusetts General Hospital has development plans (primarily office and garage parking) for a parcel of land along the east side of Nashua Street between Spaulding Rehabilitation Hospital and North Station. The site is currently used for surface parking. The parcel is divided by two zoning districts which limit maximum height levels to 150 and 300 feet, respectively.

The New Boston Garden Corporation (NBGC) announced plans in October 1990 to develop a sports arena and commercial complex with office and retail uses encompassing the site of the existing Boston Garden and adjacent areas north of Causeway Street. Construction began in spring 1993 on the 19,500-seat sports arena, in air rights above the new MBTA garage which began construction earlier. Construction



FIGURE

3.2

Affected Environment Future Conditions

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



of office components have not yet begun. The total development is scheduled to include the uses listed in Table 3.1.

Table 3.1 New Boston Garden Development Program		
Use	Square Feet	Zoning Height (ft.)
Arena	755,500	162.5
Public concourse (from arena to Causeway Street)	16,000	55.0
Office building A	450,000	277.0
Office building B	883,000	425.0
Office building C	967,000	475.0
Total	3,071,500	
Public parking (1,100 spaces) under the site of the existing Boston Garden, which will be demolished.	517,000 (includes MBTA Green line tunnel)	
Source: New Boston Garden Development Corporation DEIR, EOE A #7701, October 1990		

Across the river in Cambridge, office buildings, a hotel, and multiple unit housing have been proposed by a private developer in the North Point area bounded by the Gilmore Bridge, commuter railroad tracks, and the Charles River.

In April 1993, Lowell Square Associates announced plans to construct a housing project on the last parcel of the West End Urban Renewal Area adjacent to Charles River Park. The planned development includes 104 cooperative apartments, 85 elderly units, a West End Visitors Center, underground parking for 110 cars, and 5,000 square feet of commercial space at the corner of Stanford Street and Lomasney Way, south of and near the Project right-of-way.

3.3 SUMMARY

Generally, the existing and planned land use/development in the Area North of Causeway Street Project subarea has not changed since the 1991 FSEIS/R was published in November 1990. The most important changes are the initiation of new construction on the MBTA parking garage and new arena atop it behind North Station, and the near completion of the CANA project in Charlestown.

4. Environmental Consequences

Chapter 4

ENVIRONMENTAL CONSEQUENCES

This chapter describes the long-term environmental consequences of Scheme Z and the three new design alternatives. Subject categories included are the following : transportation, land use, air quality, noise and vibration, aquatic resources, threatened and endangered species, historic and archaeological preservation, hazardous waste sites, visual impacts, energy, the relationship of local short-term uses versus long-term productivity, and the irreversible and irretrievable commitment of resources.

4.1 TRANSPORTATION

4.1.1 Introduction

This chapter analyzes transportation impacts of each of the three new Charles River crossing design alternatives. The analysis compares traffic conditions on mainline highway segments and surface streets, in terms of traffic volumes and operational characteristics, including speeds and standard measures of level of service (LOS). Broader transportation system impacts also are documented, consisting of changes in HOV and public transportation facilities, parking supply characteristics, and pedestrian and bicycle circulation.

The analysis focuses on impacts in the design year 2010. Traffic and transportation characteristics of the affected environment are documented in the 1991 FSEIS/R, using a base year of 1987. The base year inventory of traffic conditions was developed from an extensive field data collection effort.

Since publication of the 1991 FSEIS/R, traffic growth in the Boston metropolitan area has been minimal, as a consequence of the economic recession beginning in 1987. As an illustration, traffic count data from MHD's permanent monitoring station on the Southeast Expressway at Southampton Street show that daily traffic in both directions grew by only 1 percent over the entire 5-year period from 1988 through 1992. This is typical of other data available for this period (see Table 4.1). The analysis of 1987 base year traffic and transportation conditions presented in the 1991 FSEIS/R therefore remains a valid representation of the affected environment. Information on existing transportation conditions is presented in this DSEIS/R only to the extent that it is essential as background to the analysis of Project impacts in the year 2010.

Study Area. The transportation study area for this DSEIS/R covers downtown Boston north of State Street, I-93 as far north as the Somerville boundary line, Charlestown, East Cambridge, and eastern Somerville (see Figure 4.1). The area covered by the Projectwide traffic modeling network is in the process of being expanded to cover the central and western section of Cambridge and Somerville and I-93 as far north as the Medford town line, which will extend the distance covered on I-93 by about 1.5 miles. The modeling network also is being expanded at the southwest end of the Central Artery/Tunnel Project area.

The purposes of modifying the modeling network are to assist MHD in refining the design of the preferred alternative for the Charles River crossing (to be evaluated in the FSEIS/R) and to provide improved construction planning capability for the entire Central Artery/Tunnel Project, independent of this DSEIS/R. The existing DSEIS/R study area encompasses all of the roadway links and intersections within approximately 1 mile of the Charles River crossing to the north, west, and east, and several miles

to the south. Impacts related to the Charles River alternatives diminish with distance, such that differences among the alternatives at the farther reaches of the existing study area tend to be negligible. No changes in the relative differences among the alternatives are expected based on the forecasting results of the expanded network model.

Forecasting Methodology. The process used in forecasting year 2010 traffic conditions is essentially the same as that described in a technical support document for the 1991 FSEIS/R, *Detailed Technical Model Documentation*, February 1990. It incorporates the following forecasting elements, as specified in FHWA guidelines and the standard practice of the transportation planning profession:

- Land Use: changes in land use that will affect travel patterns and volumes in future years
- Trip Generation: forecast numbers of trips per person or per square feet of development, as appropriate
- Trip Distribution: allocation of trips generated between points of origin and destination
- Mode Choice: mode of travel (e.g., private automobile, public transportation) that will be used for travel between points of origin and destination (in terms of a proportion of total number of trips forecast for each origin/destination pair)
- Traffic Assignment: specific routes that will be used on highway and public transportation networks for each vehicle or transit person trip

Updates of the process used in developing traffic volume forecasts since the 1991 FSEIS/R are described in a technical support document to this DSEIS/R.

Impact Summary. The principal transportation impacts for the four Charles River crossing designs are summarized below and in Table 4.2.

Local Streets And Intersections: Each of the new design alternatives--Alternative 8.1D Mod 5, the Reduced River-Tunnel Alternative, and the Non-River-Tunnel Alternative--has the positive impact of decreasing traffic volumes on the network of local and arterial streets, as a result of two factors. The first factor is the elimination of the need for double crossings of the Charles River for several major traffic movements, as required with Scheme Z. By eliminating these double crossings, additional capacity is made available on I-93, which causes traffic to shift to I-93 from surface streets. The second factor contributing to reduced traffic on local and arterial streets is the inclusion in the three new design alternatives of a northbound on-ramp in the upper downtown area. As a result, traffic volumes are substantially lower with the three alternatives than with Scheme Z at a number of major intersections, including Keany Square, City Square, Sumner Tunnel/Cross Street, and Gilmore Bridge/O'Brien Highway.

All three new design alternatives result in a further reduction in traffic volume and improved operations in City Square, because the local Charlestown off-ramp is located to the north of the Gilmore Bridge on Rutherford Avenue. This ramp is located in City Square with Scheme Z, causing City Square to fail under that design.

Eastbound traffic on Storrow Drive encounters greater delays with 8.1D Mod 5 than with the other designs including Scheme Z. This is due to the absence of a grade separation at Leverett Circle. As a result, traffic tends to divert from Storrow Drive to Charles Circle, where traffic volumes are higher than with the other designs. Peak hour operating speeds in the eastbound direction are only 1 to 2 miles per hour (mph) with 8.1D Mod 5, versus 17 to 19 mph with the other designs.

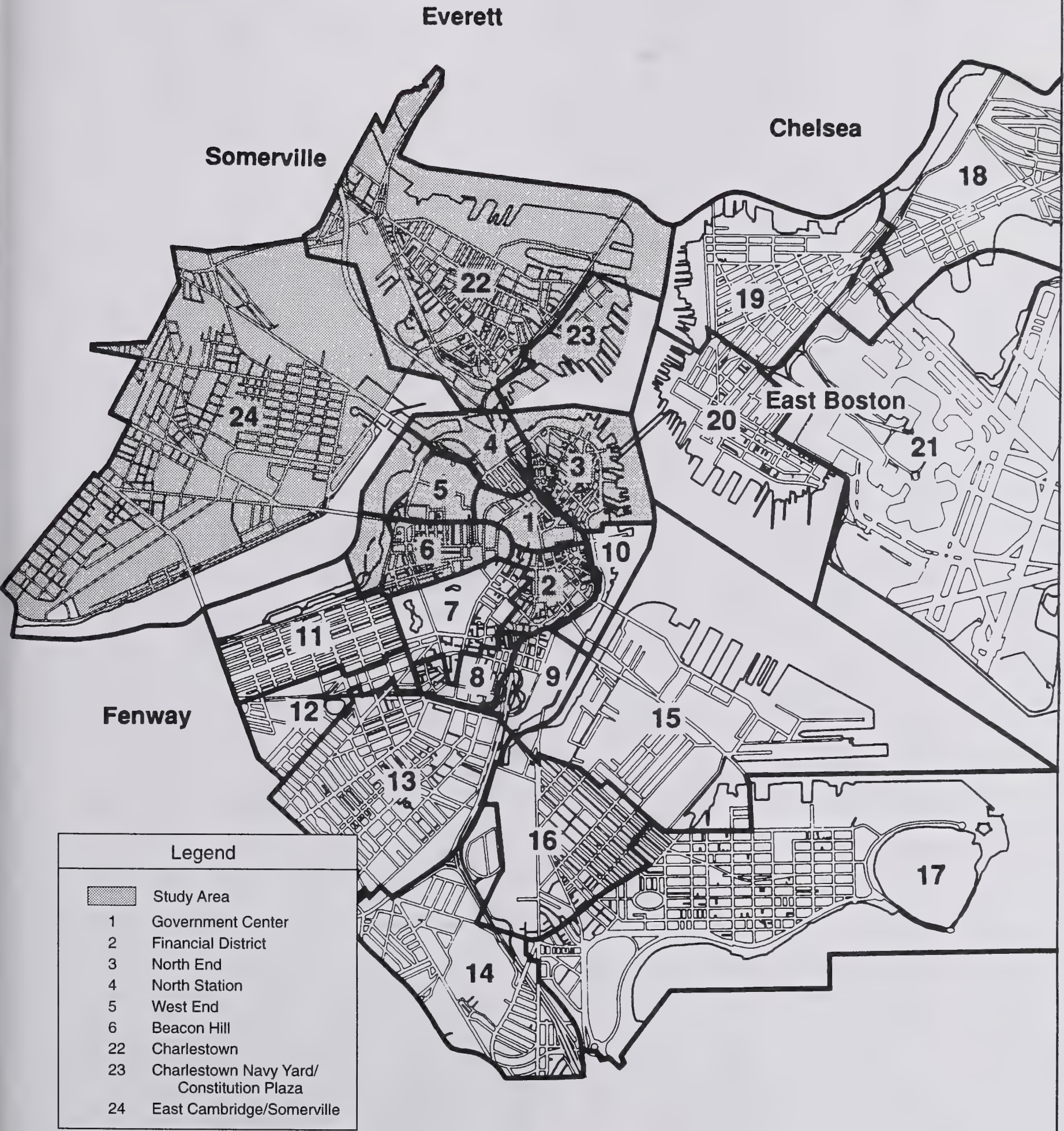
The number of intersections operating at LOS F in the PM peak hour is highest with Scheme Z (8), and lowest with the Non-River-Tunnel Alternative (4). In the AM peak hour, nine intersections operate at

Table 4.1

**COMPARISON OF DAILY TRAFFIC VOLUMES ON MAJOR
BOSTON AREA HIGHWAY FACILITIES, 1988 AND 1992**

Highway Facility	1988	1992	% Change
Route 1 (north of Boston)	71,000	71,100	0.1%
Massachusetts Turnpike	79,900	80,900	1.3%
Southeast Expressway	181,100	182,800	0.9%
Sumner Tunnel	47,800	46,200	-3.3%
I-93 (north of Boston)	138,300	141,100	2.0%

Source: Central Transportation Planning Staff



FIGURE

Transportation Study Area

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



Table 4.2

SUMMARY COMPARISON OF MAJOR OPERATING STATISTICS – YEAR 2010

Major Operating Statistic	AM Peak				PM Peak				Daily			
	Scheme "Z"	8.1D Mod 5	River Tunnel	Non- River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Non- River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Non- River Tunnel
Travel Time (minutes)												
Northbound –	3.36	3.89	3.58	3.67	6.35	4.76	5.18	5.09	n/a	n/a	n/a	n/a
* Southbound –	5.11	6.65	6.95	6.97	3.63	6.32	3.90	4.38	n/a	n/a	n/a	n/a
Eastbound –	5.42	5.02	2.77	4.99	8.19	6.89	5.09	6.74	n/a	n/a	n/a	n/a
Westbound –	6.53	8.19	13.15	13.06	5.97	6.93	10.70	10.74	n/a	n/a	n/a	n/a
Average Travel Speed (mph)												
Northbound –	39	33	36	36	21	27	25	26	n/a	n/a	n/a	n/a
* Southbound –	26	20	19	19	36	21	34	30	n/a	n/a	n/a	n/a
Eastbound –	32	31	43	35	21	22	23	26	n/a	n/a	n/a	n/a
Westbound –	27	21	13	13	30	25	16	16	n/a	n/a	n/a	n/a
I-93 Mainline Volumes Across Charles River												
Northbound –	7,734	5,078	5,804	5,930	8,831	6,800	8,418	8,973	n/a	n/a	n/a	n/a
Southbound –	9,583	7,290	7,289	7,339	8,324	6,759	6,626	6,667	n/a	n/a	n/a	n/a
Daily Vehicle Miles of Travel, ANOC Area	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2,066,283	2,009,901	2,005,050	2,030,603
Daily Vehicle Hours of Travel, ANOC Area	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	164,391	161,118	163,316	165,863
Number of Intersections Operating at Level of Service "F"	8	8	7	8	8	6	5	4	n/a	n/a	n/a	n/a

Northbound = (Mainline NB from Essex/Northern On – Ramp to Sullivan Square)

Southbound = (Mainline SB from Sullivan Square to Sudbury On – Ramp)

Eastbound = (Storrow Drive EB from Blossom Street to Tobin Bridge at End of CANA Tunnel)

Westbound = (Tobin Bridge WB from Start of CANA Tunnel to Storrow Drive at Blossom Street)

* note: In the case of 8.1D Mod 5, the Reduced River Tunnel and the Non-River Tunnel alternatives, traffic operations in southbound general-purpose lanes reflect commitment to allocating a lane for exclusive HOV use, which is forecast to be substantially below capacity, resulting in increased traffic volumes and reduced speeds in general-purpose lanes. Increased HOV use will improve general-purpose speeds.

LOS F with Scheme Z and Alternative 8.1D Mod 5, and eight intersections operate at LOS F with the Reduced River-Tunnel and Non-River-Tunnel Alternatives. With few exceptions, traffic operations on local and arterial streets are better with any of the three new design alternatives than with Scheme Z.

I-93 Northbound: Northbound traffic operations on I-93 crossing the Charles River are better with the new design alternatives than with Scheme Z, as a result of the increased capacity created by the tunnel/viaduct structures incorporated into the new designs. The I-93 on-ramp from Northern Avenue, however, creates a weave segment on I-93 northbound south of the Charles River that causes lower but still acceptable operating speeds.

I-93 Southbound: Traffic operations on the southbound mainline prior to crossing the Charles River are poorer with 8.1D Mod 5 than with the other designs, including Scheme Z. This negative impact results from the capacity constraint caused by the merge of the on-ramp from the Tobin Bridge with the mainline. On the segment of I-93 to the north of the Tobin Bridge on-ramp, operating speeds for general-purpose traffic are lower for all new design alternatives than for Scheme Z, due to reduced capacity and increased ramp traffic volume. The designation of a lane for exclusive HOV use causes the reduction in southbound general-purpose capacity, resulting in increased congestion and reduced operating speeds in general-purpose lanes. Modest increases in the use of the HOV lanes above forecasted levels would substantially improve southbound general-purpose speeds and travel times for the new design alternatives. Speeds are higher for the new design alternatives to the south of the Charles River than for Scheme Z.

HOV Operations: The new design alternatives incorporate a southbound HOV lane on the I-93 mainline, which is not included in Scheme Z. The HOV treatment included in Scheme Z is a lane on the Nashua Street off-ramp, which could be designated only with pavement striping. The advantage for HOVs relative to general-purpose traffic is greater with the new design alternatives. All design alternatives are compatible with a contraflow HOV lane concept, such as has been proposed for I-93 to the north of the Project limits.

The three new alternatives provide superior bus access to I-93 northbound compared to Scheme Z. Access from potential bus terminal in the area south of Causeway Street or Haymarket is via the New Sudbury Street on-ramp with the three new design alternatives. With Scheme Z, bus access to I-93 northbound is substantially more circuitous via Leverett Circle or Assembly Square, which is north of the Project limits.

Hazardous Cargo: Existing primary hazardous cargo routes within the Project limits are not affected by any of the design alternatives. Additional hazardous cargo route connections to the tunnels being constructed as part of the CANA project are possible with Scheme Z and the Non-River-Tunnel Alternative, but not with Alternative 8.1D Mod 5 or the Reduced River-Tunnel Alternative.

Vehicle Miles Travelled/Vehicle Hours Travelled: The three new design alternatives reduce Projectwide vehicle miles travelled (VMT) and vehicle hours travelled (VHT) by 1 to 3 percent compared to Scheme Z. For the traffic modeling sites closest to the Charles River crossing, variations among all four designs are less than 3 percent.

4.1.2 Impacts

4.1.2(a) Traffic Volumes

In the year 2010, the alternatives result in a shift in daily traffic volumes to the expressway system and away from local and arterial streets, as compared to Scheme Z. This positive impact on surface street traffic conditions is due to elimination of the double river crossings required for several major traffic movements with Scheme Z. This more direct routing of traffic allows available expressway capacity to be used more efficiently by a greater number of vehicles. Differences in traffic patterns associated with the four designs are described in this section for the I-93 mainline, Storrow Drive, connectors between Storrow Drive, I-93 and the Tobin Bridge, and surface streets within the study area for this DSEIS/R, in terms of average weekday daily traffic (AWDT) in the design year 2010.

The alternatives generally have similar impacts on the distribution of traffic volumes. Much of the analysis in this section therefore contrasts them as a group with Scheme Z. To the extent that there are differences among the three new alternatives, these also are identified.

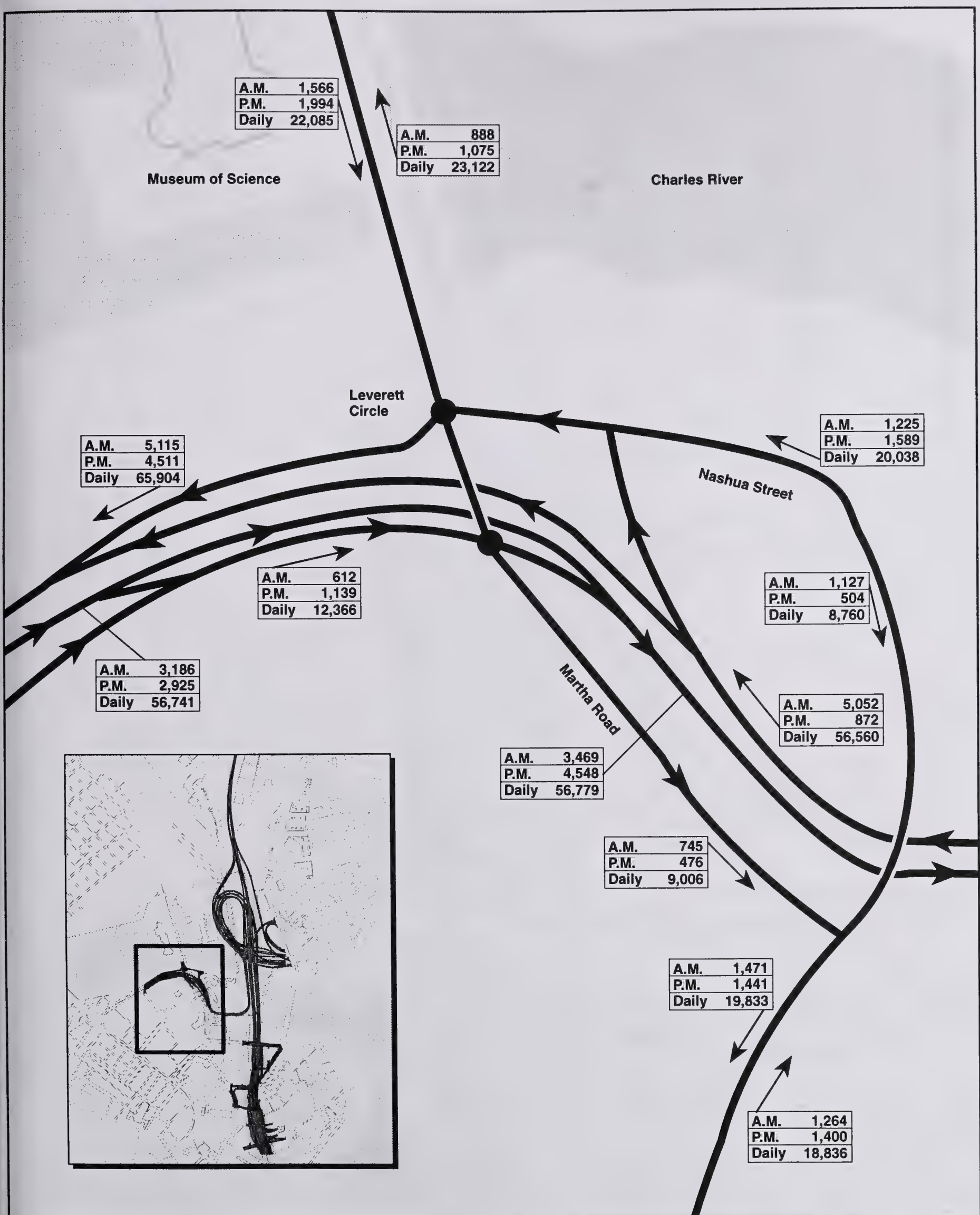
I-93 Mainline Traffic Volumes. Variations in daily traffic volumes on the I-93 mainline among Scheme Z and the three new design alternatives are due to a number of factors. With Scheme Z, circuitous double crossings of the Charles River are required for traffic movements from I-93 northbound to Storrow Drive and from Storrow Drive to I-93 southbound. Portions of these movements occur on the I-93 mainline, increasing total traffic volumes. The new design alternatives carry lower mainline traffic volumes as a result of eliminating the double crossings. For this reason, it is possible to reduce the width of the bridge over the Charles River from five southbound mainline lanes under Scheme Z to four southbound mainline lanes with all alternatives.

Additional variations in mainline traffic volumes are related to differences in ramp configuration, with the proportion of vehicles carried on ramps, connectors, and mainline highway segments differing among the four designs. (AWDT on mainline highway segments is shown in the Transportation Appendix and Figures 4.2 to 4.9.)

Total Mainline And Local/Arterial Volumes. Total AWDT in the year 2010 for the four Charles River crossing designs, including mainline highway sections and connectors to the Tobin Bridge and Storrow Drive, are as follows:

Design	Number Of Vehicles
Scheme Z	277,500
Alternative 8.1D Mod 5	289,800
Reduced River-Tunnel Alternative	288,600
Non-River-Tunnel Alternative	286,300

The above forecasts do not include the excess travel caused by the circuitous double river crossings required with Scheme Z. The AWDT volume forecast for each of the three new design alternatives represents an increase of 3 to 4 percent compared to Scheme Z, exclusive of the double crossings. Differences in AWDT among the three new design alternatives are minor. The above figures represent the results of a screenline analysis used to compare the impacts on traffic patterns associated with each of the design alternatives under study. Imaginary screenlines are used to define a cordon across parallel roadways. Total traffic volume and volume shifts among the parallel roadways crossing the screenlines are compared for the alternative designs.



FIGURE

4.2

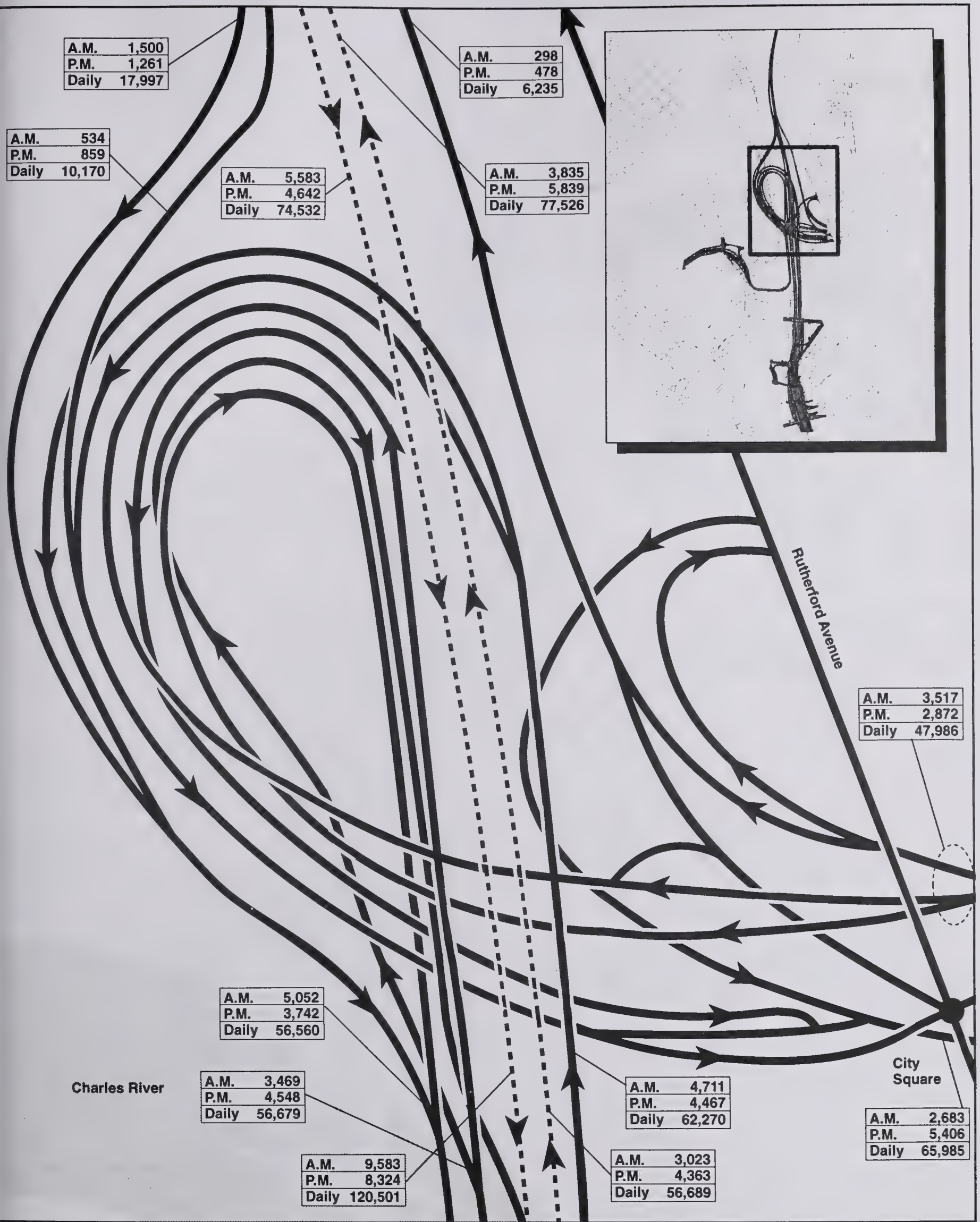
Peak Hour Traffic Volume Leverett Circle Year 2010: Scheme Z

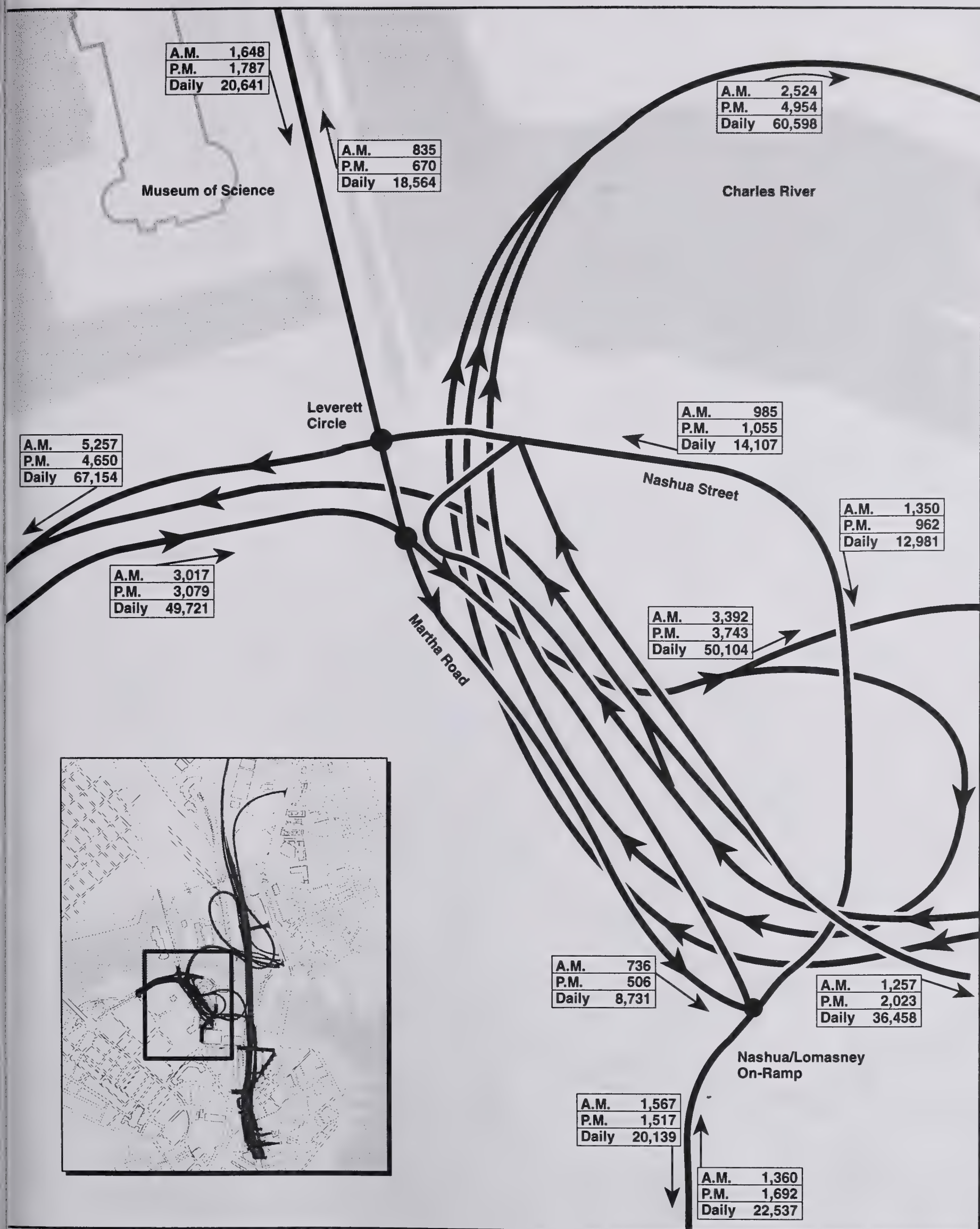
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale







FIGURE

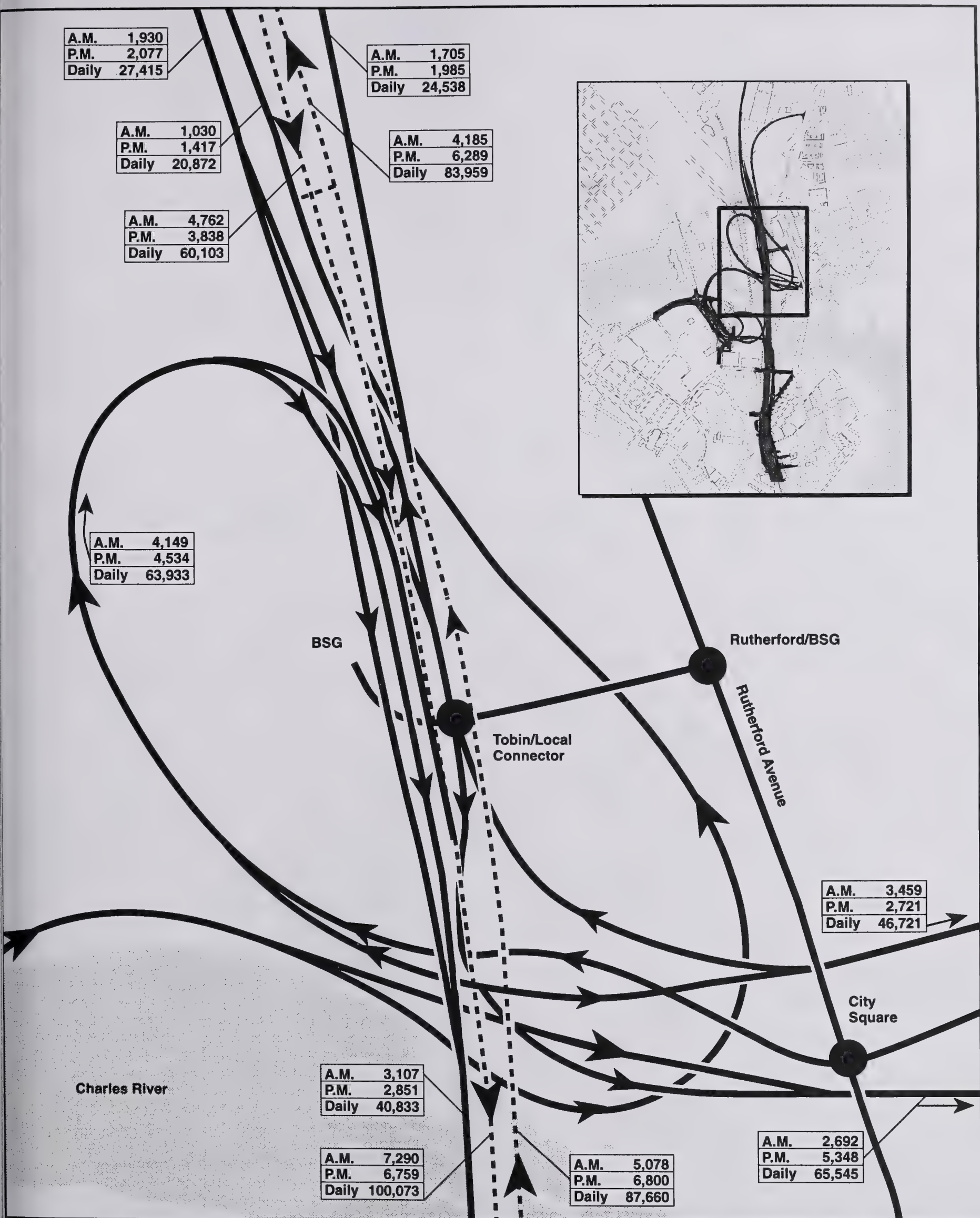
4.4

**Peak Hour Traffic Volume
Leverett Circle Year 2010:
Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale





FIGURE

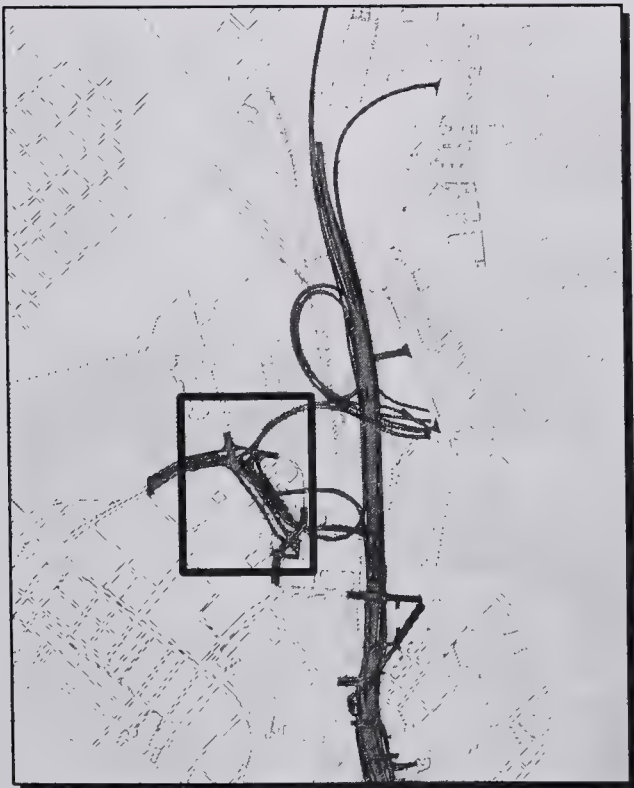
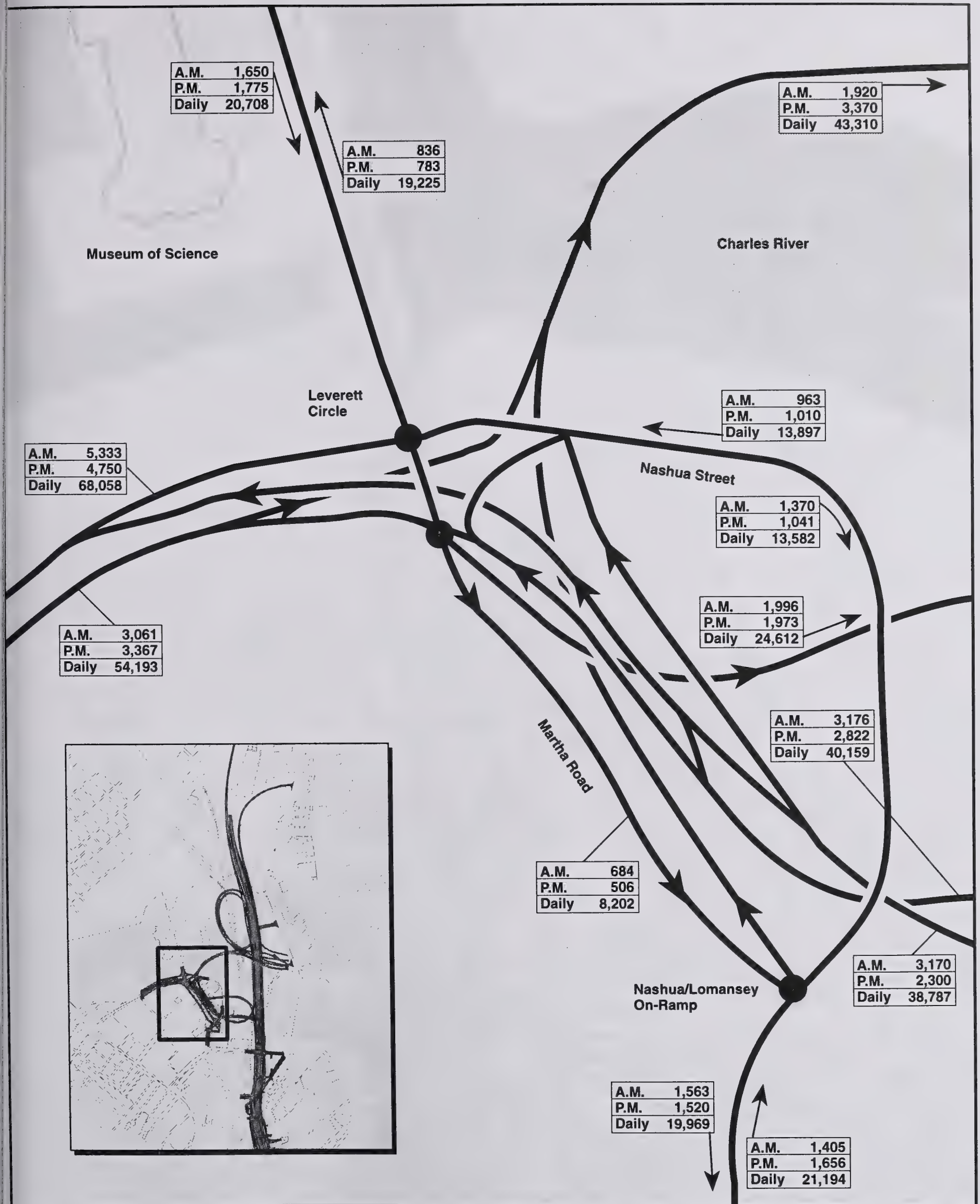
4.5

**Peak Hour Traffic Volume
Charlestown Year 2010:
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R**

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale





FIGURE

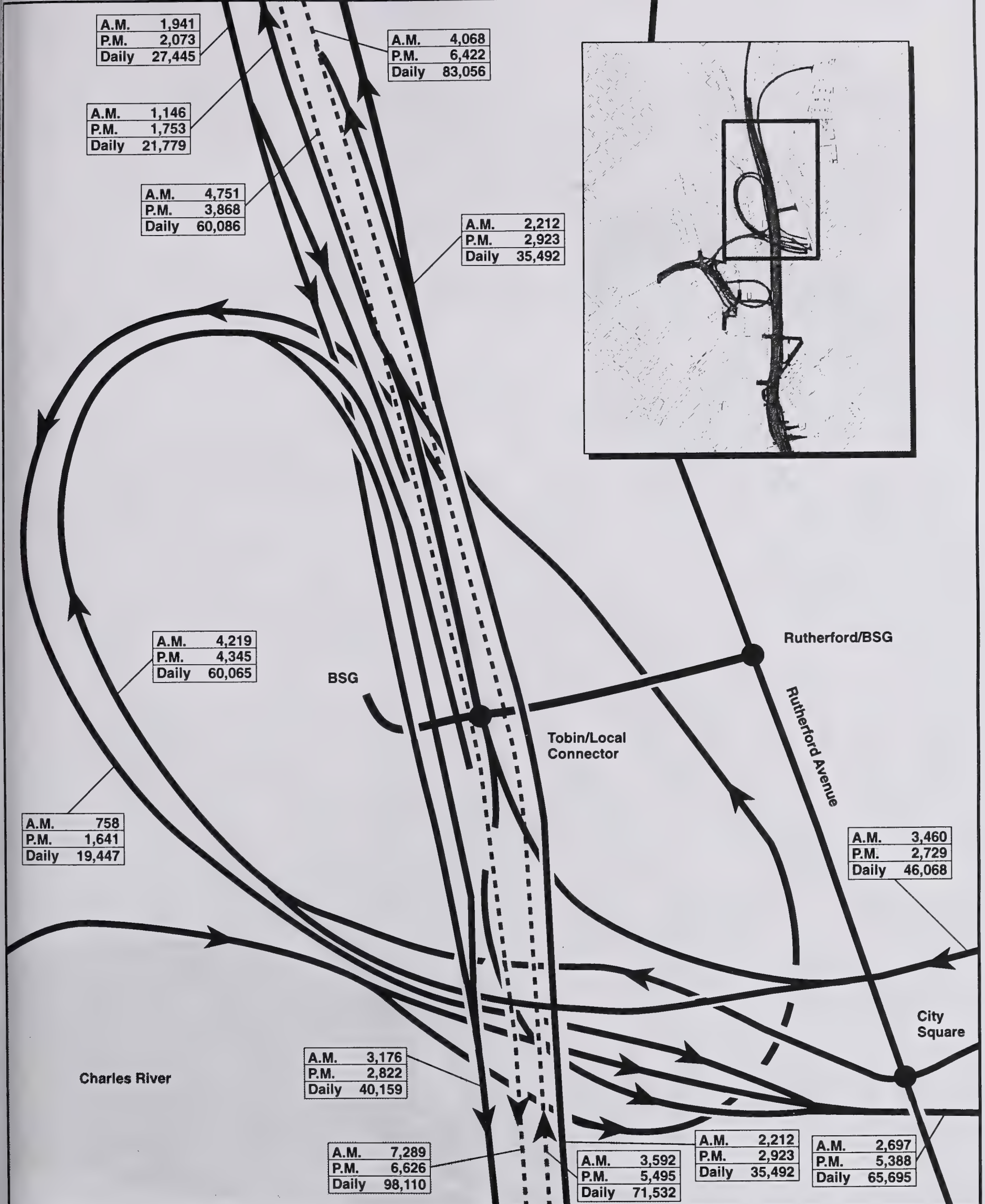
4.6

Peak Hour Traffic Volume Leverett Circle Year 2010: Reduced River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale





FIGURE

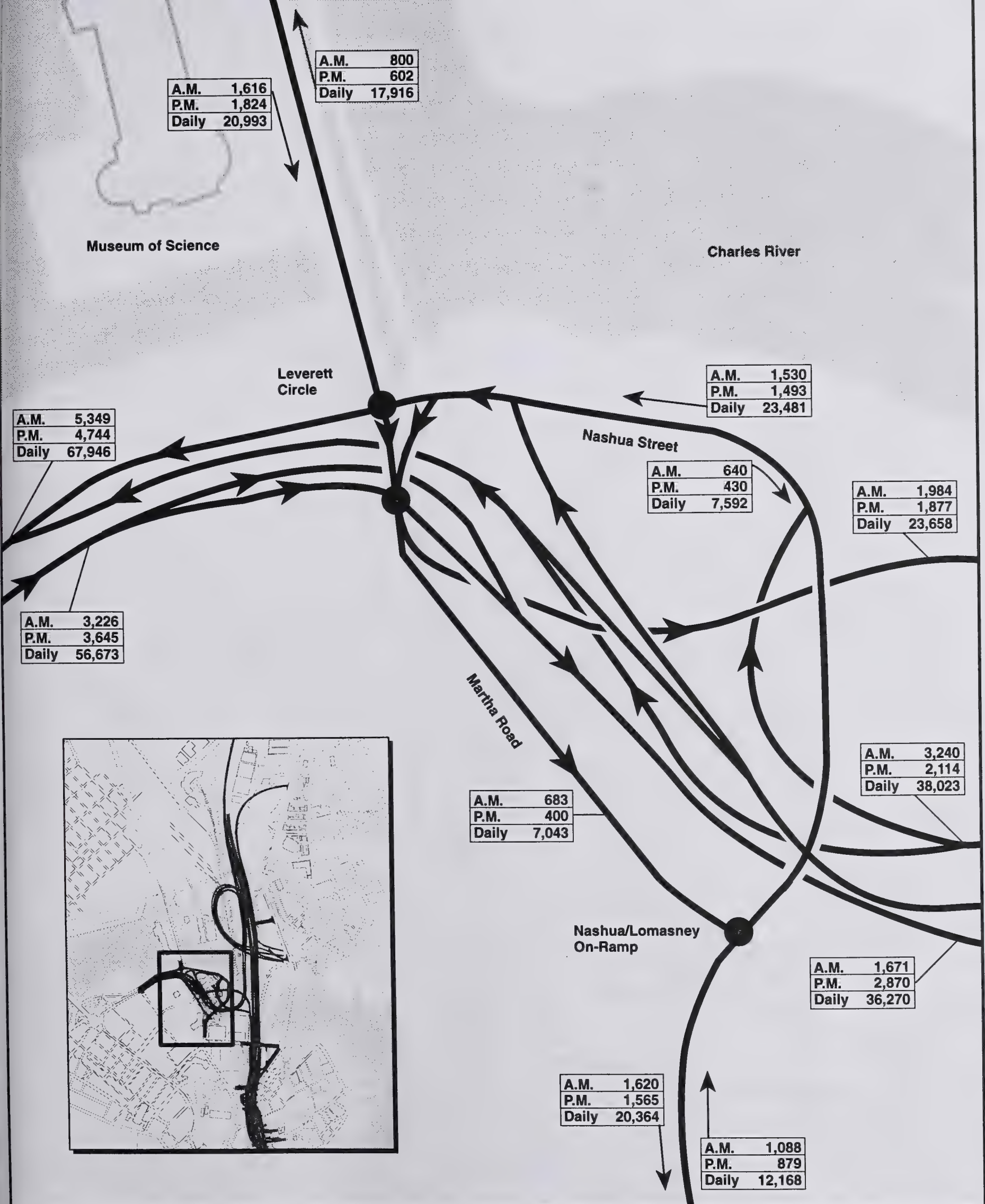
4.7

Peak Hour Traffic Volume Charlestown Year 2010: Reduced River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale





FIGURE

4.8

Peak Hour Traffic Volume Leverett Circle Year 2010: Non-River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale



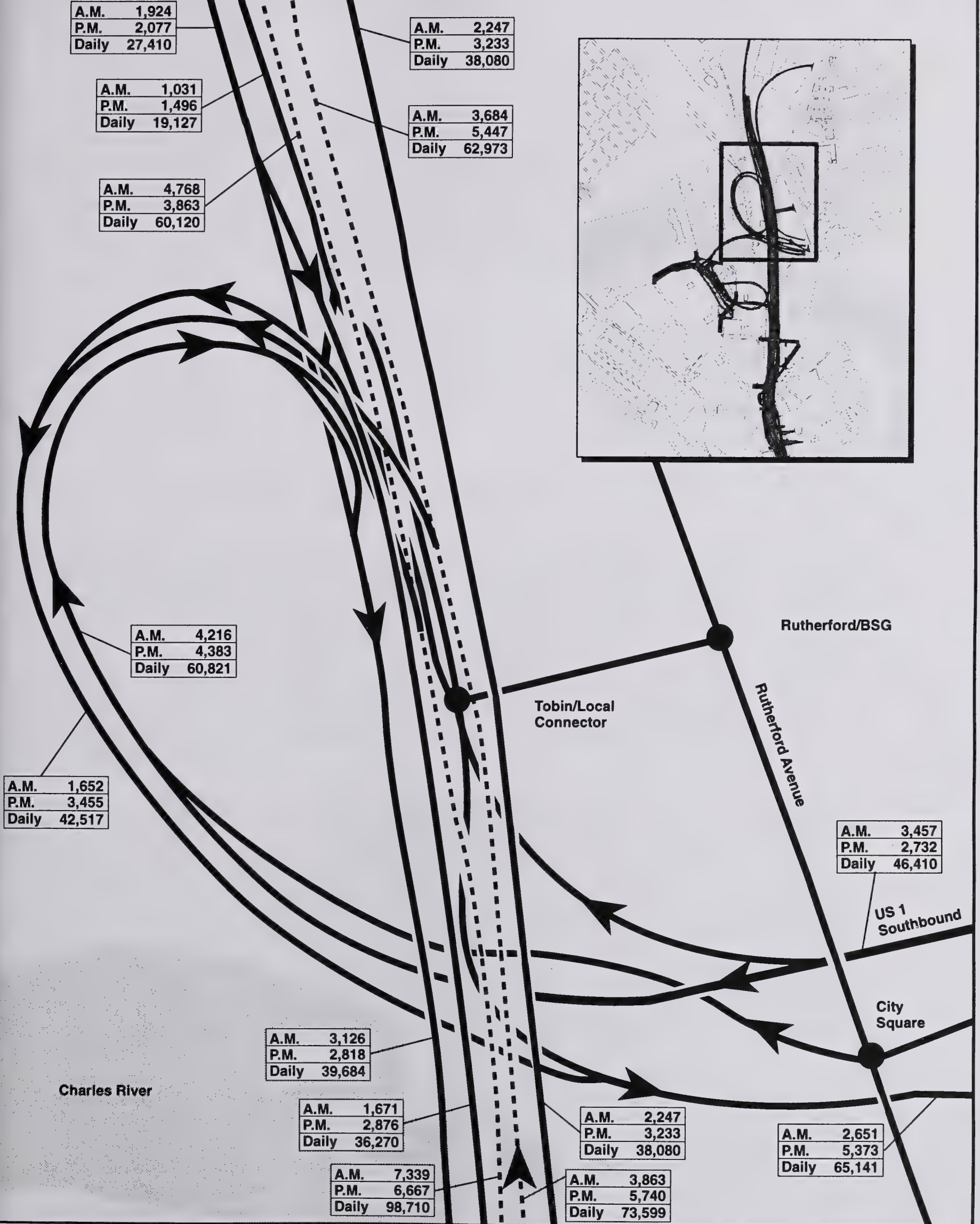
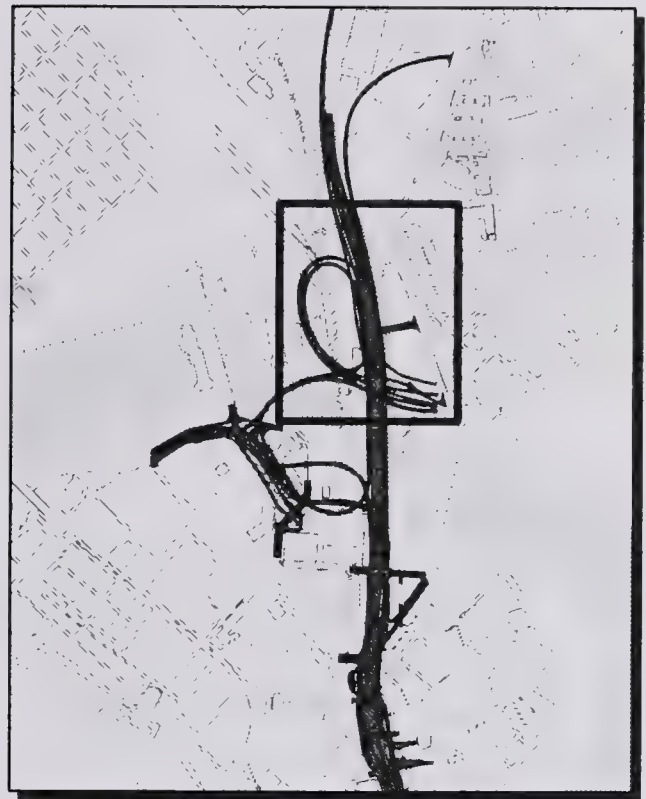
A.M.	1,924
P.M.	2,077
Daily	27,410

A.M.	2,247
P.M.	3,233
Daily	38,080

A.M.	1,031
P.M.	1,496
Daily	19,127

A.M.	3,684
P.M.	5,447
Daily	62,973

A.M.	4,768
P.M.	3,863
Daily	60,120



FIGURE

4.9

**Peak Hour Traffic Volume
Charlestown Year 2010:
Non-River-Tunnel Alternative**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale



The increase in daily expressway traffic associated with the three new design alternatives results primarily from the diversion of vehicles away from the local street system, in response to the elimination of the double crossings required with Scheme Z, and the addition of a northbound on-ramp in the upper downtown area. This represents a positive impact to local streets. This shift in traffic patterns is reflected in the AWDT reductions forecast for the local bridge crossings of the Charles River. Traffic volume is lower on each of the local bridge crossings North Washington Street, Charles River dam [i.e., O'Brien Highway], Longfellow Bridge, and Harvard Bridge) with the new design alternatives, as compared to Scheme Z. Collectively, the local bridges carry 7 to 8 percent fewer vehicles per day.

Considering both expressway and local roadway traffic volumes combined, each of the new design alternatives results in a slight reduction (less than 1 percent) in weekday traffic volumes in both directions over all the Charles River crossings, not counting the impact of eliminating the double river crossings of Scheme Z. Accounting for the double crossing, the new design alternatives reduce the daily crossing volume by approximately 77,000 vehicles, with the Non-River-Tunnel Alternative showing the greatest reduction in traffic volume.

Leverett Circle/Storrow Drive/Charles Circle Traffic Volumes. The following three locations are discussed because of the differences among the four designs.

Leverett Circle: The total volume of traffic entering and leaving Leverett Circle varies by only a small amount among all four Charles River crossing designs. An important design difference among the three alternatives to Scheme Z relates to the treatment of eastbound Storrow Drive traffic. All of the alternatives except 8.1D Mod 5 incorporate a tunnel under Leverett Circle for all or some portion of this eastbound traffic. This provides a grade separation which results in improved traffic flow. Under 8.1D Mod 5, all eastbound vehicles on Storrow Drive travel at grade through the signalized Leverett Circle intersection. With the Reduced River-Tunnel and Non-River-Tunnel Alternatives, eastbound traffic destined for I-93 north and the Tobin Bridge travels under Leverett Circle, while vehicles destined for I-93 southbound travel at grade through Leverett Circle. Thus, some but not all of eastbound Storrow Drive traffic is grade separated.

Storrow Drive: The delays experienced by eastbound Storrow Drive traffic in the case of 8.1D Mod 5 result in a diversion of traffic to parallel surface streets, which is a negative impact. This shift in traffic patterns is reflected in a reduction in AWDT on eastbound Storrow Drive. Storrow Drive eastbound approaching Leverett Circle carries 18,000 fewer vehicles per day with 8.1D Mod 5 as compared to Scheme Z. Differences among the alternatives in eastbound Storrow AWDT are minor, ranging from 2,100 to 3,500 vehicles per day for the Non-River-Tunnel and Reduced River-Tunnel Alternatives, respectively. Eastbound volumes on Storrow Drive approaching Leverett Circle are higher with Scheme Z than with the new design alternatives; westbound volumes from the Central Artery ramps are lower. These lower volumes are the result of the greater circuitousness and longer times involved in travelling on the ramps. Lower westbound traffic volume on Storrow Drive results in increased traffic on other roadways. Total approach volumes from all directions at Leverett Circle are similar, therefore, for all four designs.

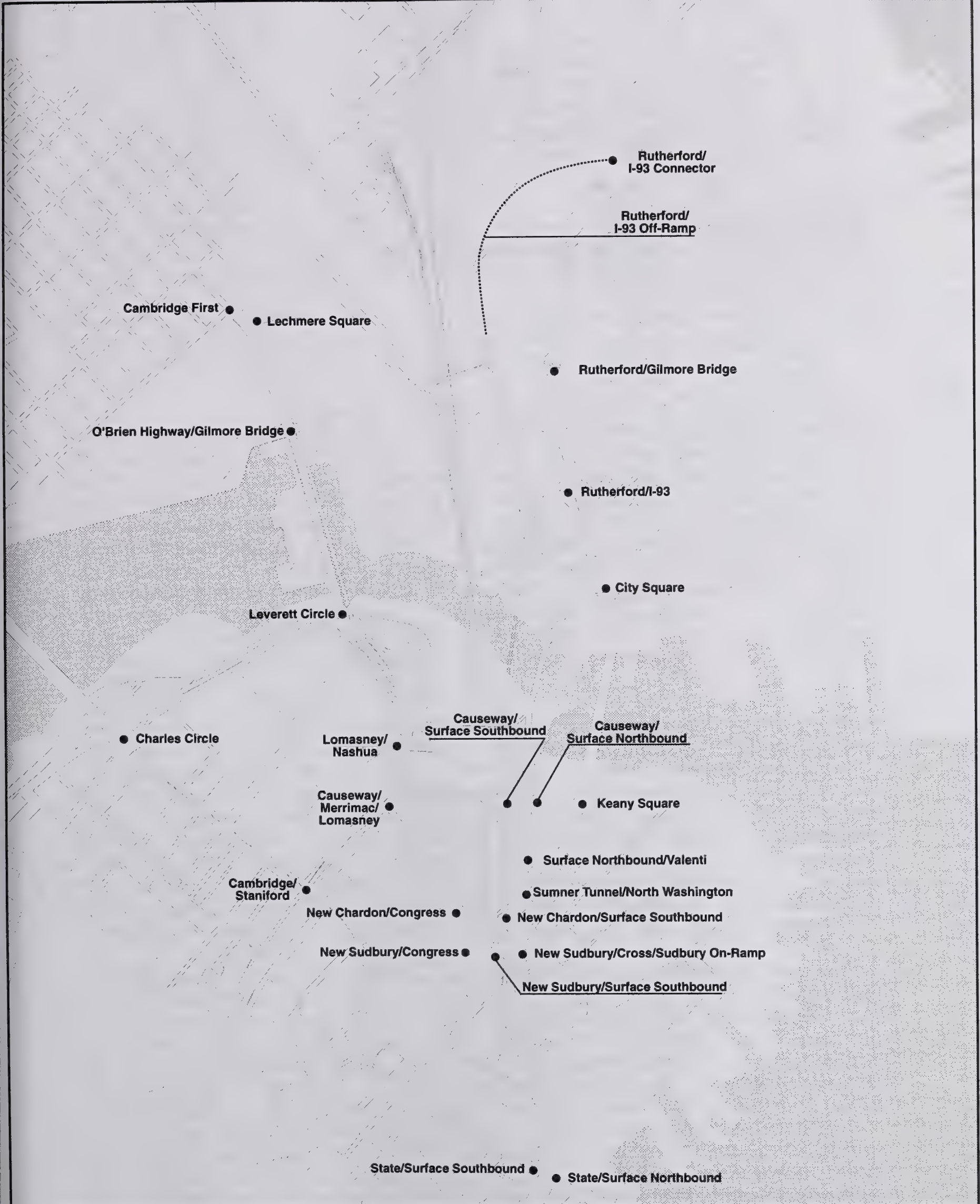
To the west of Leverett Circle, Storrow Drive eastbound carries higher traffic volumes from points in the Back Bay with Scheme Z than the new design alternatives (see Table 4.4). Traffic volumes are a few thousand vehicles lower per day for 8.1D Mod 5 than for the other new design alternatives, because the absence of grade separation at Leverett Circle reduces capacity. As a consequence, diversions to Charles Circle and other local roadways are higher. Westbound Storrow Drive AWDT to the west of Leverett Circle is essentially the same for all four designs.

Charles Circle: Traffic volumes entering Charles Circle from eastbound Storrow Drive are highest in the case of 8.1D Mod 5, reflecting the diversion of traffic away from the Leverett Circle intersection to other surface streets. As indicated earlier, this shift in traffic to local streets is an adverse impact. AWDT entering Charles Circle from all directions combined is similar for the three new design alternatives, and 4 to 6 percent higher for these alternatives than for Scheme Z, because Scheme Z carries the eastbound movements to both the northbound and southbound Central Artery in tunnel under Leverett Circle, in effect providing greater capacity and superior operations on Storrow Drive for the greatest number of vehicles. Because the new design alternatives require some or all of eastbound movements to travel through Leverett Circle at grade, effective capacity is decreased and diversions to Charles Circle are increased by a few thousand vehicles on a daily basis, compared to Scheme Z.

Intersection Volumes. AWDT at intersections within the study area has been compared for all four designs. The total volume of traffic entering individual intersections throughout the day serves as an indicator of changes in circulation patterns, numbers of vehicles on local and arterial roadways, and intersection demand levels. AWDT has been forecast for 25 intersections in the study area for the Charles River crossing. These intersections, shown in Figure 4.10, have been selected because of their potential sensitivity to changes in the design of the crossing, in terms of traffic flow and air quality. Data for individual intersections are shown in the Appendix A.

Traffic volumes do not vary substantially among the designs at most of the intersections analyzed. Several changes in circulation patterns, however, cause changes at a few intersections. These impacts are as follows:

- Daily intersection volumes are 5 to 25 percent higher for Scheme Z than for the alternatives at downtown intersections in the vicinity of the North Washington Street bridge, due to the absence of a northbound on-ramp in the upper downtown area (i.e., at New Sudbury Street in the other designs). The intersections include Keany Square, Causeway Street and Surface Artery (northbound and southbound), and Sumner Tunnel and Cross Street.
- Traffic volumes are 30 percent lower at City Square, and 17 to 18 percent lower at several intersections on Rutherford Avenue, with the three new design alternatives as compared to Scheme Z, as a result of two factors. The first is the inclusion, with the alternatives, of the northbound I-93 on-ramp at New Sudbury Street; the second is the relocation of the I-93 local off-ramp from City Square to a point north of the Gilmore Bridge on Rutherford Avenue. Traffic volume increases with the new design alternatives, however, at the point of the intersection of Rutherford Avenue with this local northbound off-ramp.
- Differences among the four designs are minor at all intersections in Cambridge except Gilmore Bridge/O'Brien Highway. Intersections at New Chardon and Cambridge Streets, at Leverett Circle, and at O'Brien Highway and the Gilmore Bridge have traffic volumes 6 to 12 percent higher with Scheme Z than the new alternatives. This results because more vehicles travel through these locations on an alternate northbound route toward Cambridge in the absence of a northbound on-ramp in the Government Center area.
- Traffic volumes are approximately 30 to 40 percent lower for Scheme Z than the alternatives at the intersections of New Sudbury Street with Surface Artery and Cross Street, due to the absence of the northbound on-ramp on New Sudbury Street.



FIGURE

4.10

Intersection Analysis Locations Existing Conditions

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



- Traffic volumes are about 23 percent lower for the Non-River-Tunnel Alternative than the river-tunnel alternatives at the intersection of Lomasney Way and Nashua Street, because there is no northbound on-ramp at this location.

4.1.2(b) Traffic Operations

The impacts of each of the four designs are compared in this section, in terms of both mainline highway and surface street traffic conditions. Traffic conditions are represented by operating speed and LOS, which are the standard measures of the quality of traffic operations.

Mainline Traffic Operations. Traffic conditions on the I-93 mainline are similar overall for the four designs. Differences are outlined below. (Operating speeds and LOS for the AM and PM peak hours are presented in Figures 4.11 to 4.14 and in the Transportation Appendix.)

AM Peak Hour: In the AM peak hour, northbound operating speeds on the segment of the mainline crossing the river are forecast to be 34 mph with Scheme Z, as compared to 41 mph with Alternative 8.1D Mod 5, and 45 mph with the Reduced River-Tunnel and Non-River-Tunnel Alternatives. The increase in speeds associated with the alternatives represents an improvement in LOS. In the Central Area to the south of the Essex Street/Northern Avenue on-ramp, northbound speeds in the AM peak hour are forecast to decline from about 40 mph with Scheme Z, to the range of 23 to 25 mph with each of the three new design alternatives. The reduction in speed results from the southward relocation of the off-ramp to Storrow Drive, which creates a weaving condition to the south of the off-ramp. Average northbound speeds for all four designs range from 33 to 39 mph in the AM peak hour, for the entire distance from State Street in downtown Boston to Sullivan Square at the northern Project limit. AM peak hour speeds southbound average 19 to 20 mph for the new design alternatives and 26 mph for Scheme Z, over the entire distance from Sullivan Square at the northern Project limit to New Sudbury Street in downtown Boston.

In the southbound direction, AM peak hour speeds (for general-purpose traffic) also are lower with the new alternatives than with Scheme Z on the segment of I-93 to the north of the Tobin Bridge on-ramp (north of the Charles River). This impact results from a capacity constraint where the Tobin Bridge on-ramp merges with the southbound mainline; in addition, allocating a southbound lane for exclusive HOV use reduces the capacity available for general-purpose traffic. General-purpose traffic operates at 40 mph with Scheme Z, as compared to 14 mph with the new design alternatives. Scheme Z does not include a comparable mainline HOV facility. The implementing regulations of the Clean Air Act Amendments of 1990 encourage development of HOV facilities wherever appropriate. Accordingly, the three new design alternatives incorporate a mainline HOV facility. For comparison purposes, if a mainline HOV facility were incorporated in Scheme Z a similar reduction in operation speeds would result.

Speeds in the general-purpose lanes will increase substantially with modest increases in HOV use beyond the levels forecast for the three new alternatives. A shift of 400 drivers to HOVs in the AM peak hour would increase use of the HOV lane by only 170 vehicles (assuming the forecast vehicle occupancy rate of 2.3 occupants per HOV), which would still maintain vehicular volume in the HOV lane at a level well below capacity, while increasing operating speed in the general-purpose lanes to 27 mph. HOV speeds with the three new alternatives are 35 mph. These reduced speeds result in an average delay of approximately under 2 minutes for the new design alternatives when compared to Scheme Z, while providing the benefits of an HOV facility (see Table 4.2). This small difference in travel time is because traffic operating conditions are better with any of the new design alternatives than with Scheme Z to the south of the Charles River bridge crossing. Lower volumes of traffic feed into this segment of the highway from the capacity-constrained segment to the north of the Charles River. Vehicles travel at 29 to 30 mph with the new designs, versus 13 to 27 mph with Scheme Z.

PM Peak Hour: Operating speeds in the northbound direction increase substantially with the three new design alternatives, compared to Scheme Z, on the segment of I-93 crossing the river. Vehicles travel at 35 mph with each of the new design alternatives, compared to 12 mph with Scheme Z, as a result of the reallocation of traffic to the northbound tunnel (8.1D Mod 5) or the northbound parallel viaduct (Reduced River-Tunnel and Non-River-Tunnel). In the Central Area, to the south of the Charles River, northbound traffic operations are approximately the same with all four designs in the PM peak hour. Delays caused by weaving and the rising grade at the Charles River result in speeds of about 15 mph for all four designs. PM peak hour speeds northbound average 21 mph for Scheme Z, as compared to 25 mph for the alternatives, over the total distance from State Street to Sullivan Square.

In the southbound direction in the PM peak hour, traffic operations are similar with all four designs. To the south of the Charles River, speeds are in the 30- to 35-mph range, although operations are slightly better with the alternatives than with Scheme Z, because the volume of traffic feeding into this segment of the southbound mainline is reduced somewhat for the alternatives, as in the AM peak hour. To the north of the Charles River crossing, speeds in the general-purpose lanes decline to approximately 15 mph with the alternatives as compared to 43 mph with Scheme Z, due to the capacity constraint where the Tobin Bridge on-ramp enters the mainline, assuming that a mainline lane is allocated to HOV use, as in the AM peak hour (see AM peak discussion above regarding HOV implications). In deciding whether to operate the HOV lane in the PM peak hour, MHD will determine whether the benefits offset the adverse impact on general-purpose traffic operations. The HOV lane is primarily intended to serve inbound HOVs in the AM peak hour.

On the southbound segment of I-93 crossing the Charles River, speeds are only 15 mph with 8.1D Mod 5, as compared to 30 to 35 mph with Scheme Z and the other two alternatives. This occurs because 8.1D Mod 5 feeds more traffic into the southbound mainline from the Tobin Bridge on-ramp, creating a capacity constraint. A combined on-ramp to Storrow Drive and the I-93 southbound mainline is three lanes wide with 8.1D Mod 5, and only two lanes wide with the other alternatives, prior to the Storrow Drive/I-93 split. The capacity of the combined section of the ramp, therefore, is greater with 8.1D Mod 5. PM peak hour speeds southbound average 21 mph for Alternative 8.1D Mod 5 and 30 to 36 mph for Scheme Z, the Reduced River-Tunnel, and Non-River-Tunnel Alternatives, over the entire distance from Sullivan Square to New Sudbury Street.

Operating speeds on Storrow Drive eastbound are substantially worse with Alternative 8.1D Mod 5 than Scheme Z and the other two alternatives, due to the absence of grade separation for eastbound traffic at Leverett Circle. Traffic in both the AM and PM peak hours moves at 17 to 19 mph with Scheme Z, the Reduced River-Tunnel Alternative, and the Non-River-Tunnel Alternative, as compared to only 1 to 2 mph with 8.1D Mod 5.

Massachusetts Turnpike Connections: The Certificate of the Secretary of Environmental Affairs on the 1992 NPC requires that affected connections to the Massachusetts Turnpike (Masspike) be addressed in this DSEIS/R. Neither Scheme Z nor the three alternatives provides additional connections to the Masspike, nor does any have a measurable impact on Masspike traffic conditions. Connections between the Masspike and Storrow Drive are several miles to the west of the Project limits, at the Beacon Park interchange in Allston, and require travelling via arterial roadways and a signalized intersection. Daily traffic volume on Storrow Drive to the west of Clarendon Street is virtually identical for all four designs.

Additional design options were considered by the BDRC in 1991 that would have shifted some of the functions performed by Storrow Drive to the Masspike. Analyses showed that these alternatives would not reduce traffic on Storrow Drive, or replace established connections among Storrow Drive, the Central Artery, and the Tobin Bridge. Downgrading the Storrow connections also could not improve traffic

From Project Limits		
A.M.	40 mph	LOS E
P.M.	43 mph	LOS D

To Project Limits		
A.M.	47 mph	LOS C
P.M.	40 mph	LOS D

A.M.	21 mph	LOS F
P.M.	32 mph	LOS E

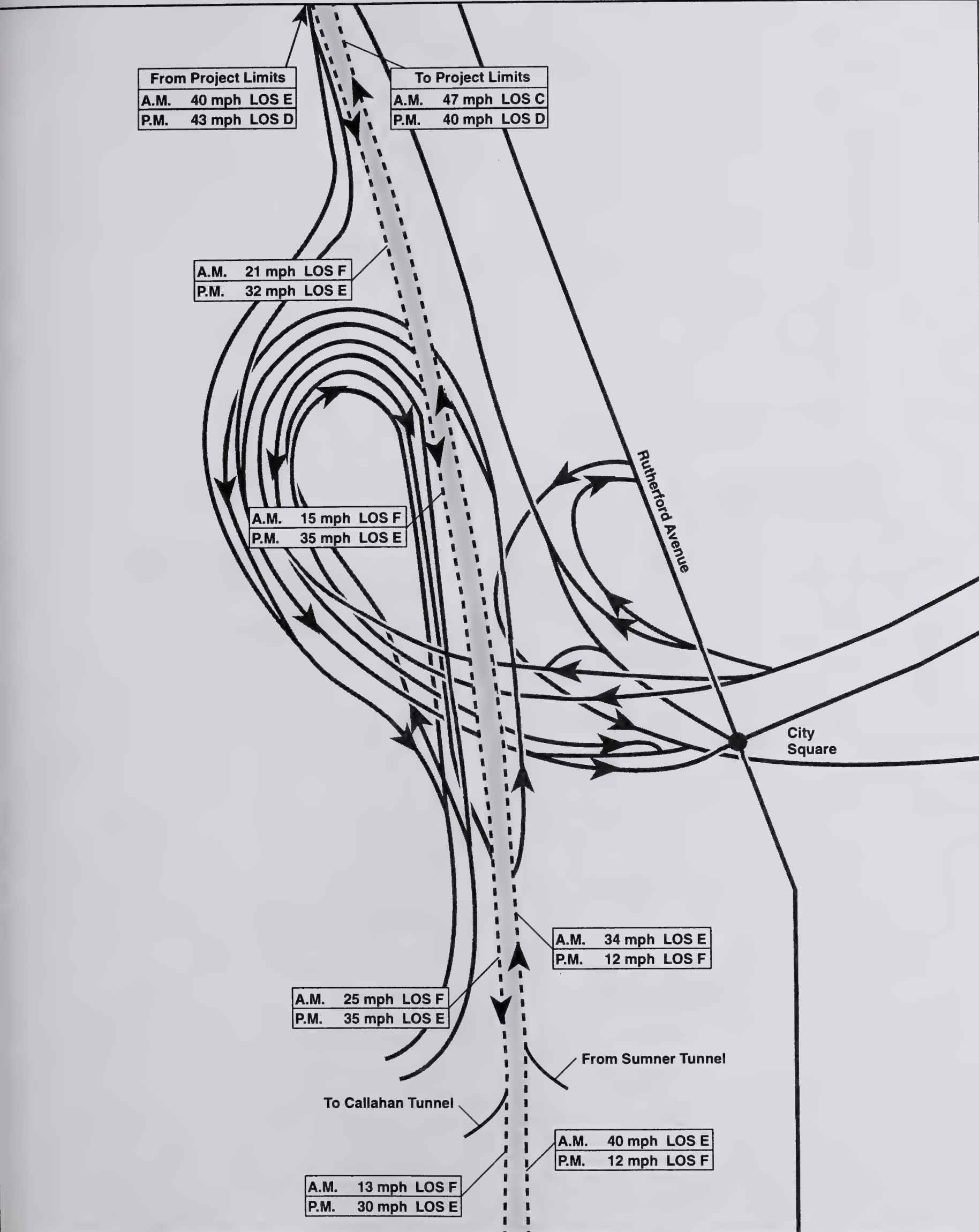
A.M.	15 mph	LOS F
P.M.	35 mph	LOS E

A.M.	34 mph	LOS E
P.M.	12 mph	LOS F

A.M.	25 mph	LOS F
P.M.	35 mph	LOS E

A.M.	40 mph	LOS E
P.M.	12 mph	LOS F

A.M.	13 mph	LOS F
P.M.	30 mph	LOS E



FIGURE

4.11

I-93 Operating Speeds And Level Of Service: Scheme Z

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale



From Project Limits	
A.M.	14 mph LOS F
P.M.	15 mph LOS F

A.M.	47 mph LOS C
P.M.	46 mph LOS C

A.M.	22 mph LOS F
P.M.	25 mph LOS F

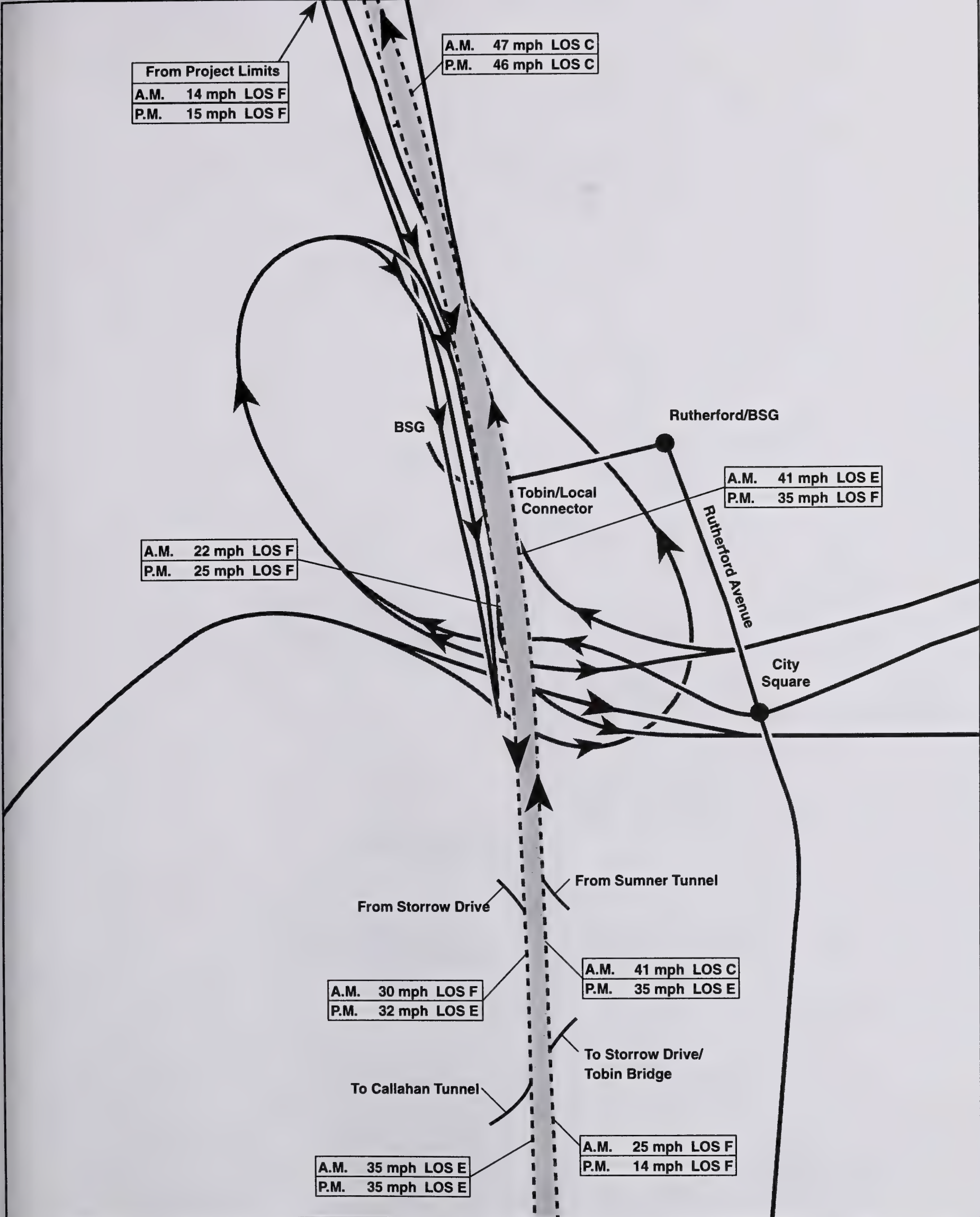
A.M.	41 mph LOS E
P.M.	35 mph LOS F

A.M.	30 mph LOS F
P.M.	32 mph LOS E

A.M.	41 mph LOS C
P.M.	35 mph LOS E

A.M.	35 mph LOS E
P.M.	35 mph LOS E

A.M.	25 mph LOS F
P.M.	14 mph LOS F



FIGURE

4.12

**I-93 Operating Speeds
And Level Of Service:
Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale



From Project Limits	
A.M.	14 mph LOS F
P.M.	15 mph LOS F

A.M.	45 mph LOS C
P.M.	42 mph LOS D

A.M.	25 mph LOS F
P.M.	35 mph LOS E

A.M.	45 mph LOS C
P.M.	35 mph LOS E

A.M.	29 mph LOS F
P.M.	32 mph LOS E

A.M.	35 mph LOS F
P.M.	33 mph LOS E

A.M.	32 mph LOS E
P.M.	35 mph LOS E

A.M.	24 mph LOS F
P.M.	15 mph LOS F

BSG

Tobin/Local
Connector

Rutherford/BSG

Rutherford Avenue

City
Square

From Storrow Drive

To City Square

To Callahan Tunnel

To Storrow Drive

FIGURE

4.13

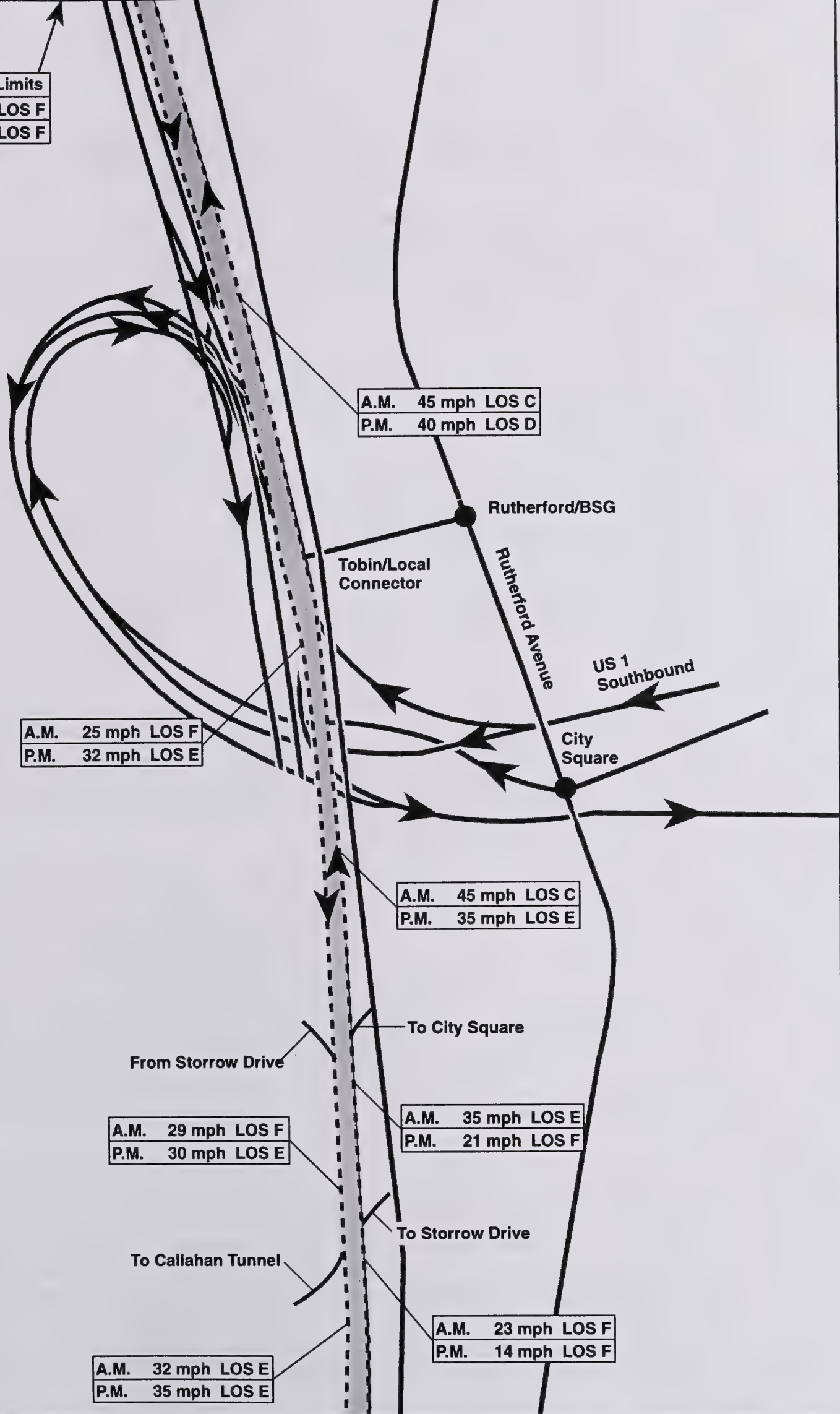
**I-93 Operating Speeds
And Level Of Service:
Reduced River-Tunnel Alternative**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale



From Project Limits		
A.M.	14 mph	LOS F
P.M.	15 mph	LOS F



FIGURE

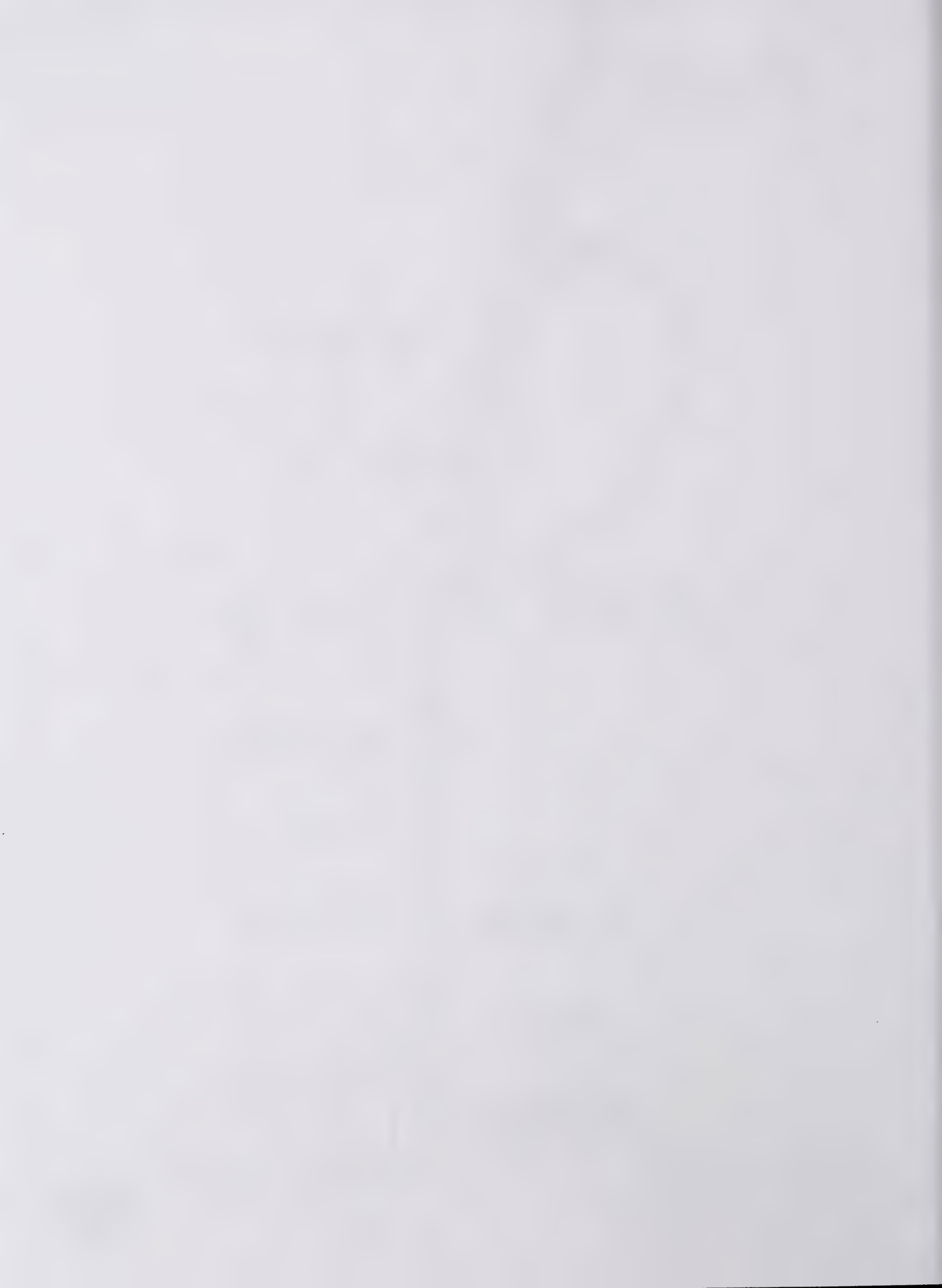
4.14

**I-93 Operating Speeds
And Level Of Service:
Non-River-Tunnel Alternative**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

Not to Scale





conditions on the Masspike, but could result in a small increase in Masspike traffic volume (1 to 2 percent), as confirmed by analysis performed in support of the BDRC. In summary, the design of the Charles River crossing will have no discernible impact on the Masspike.

Intersections. Traffic operations have been analyzed for this DSEIS/R at 25 intersections because of their potential sensitivity to changes in the design of the Charles River crossing. These intersections are located in Beacon Hill, Charlestown, Cambridge, and the section of the downtown area to the north of State Street (see Tables 4.3 and 4.4, and Figure 4.10).

In the AM peak hour, nine intersections operate at LOS F (defined as delays of 60 seconds or more) with Scheme Z and 8.1 D Mod 5, while eight intersections operate at LOS F with the Reduced River-Tunnel and Non-River-Tunnel Alternatives. In the PM peak hour, there are fewer LOS F intersections for all the designs. The greatest number of LOS F intersections in the PM peak hour occurs with Scheme Z (eight), and the fewest with the Non-River-Tunnel Alternative (four). Major intersections that operate at LOS F with all designs in the AM peak hour are Keany Square, New Chardon/Congress Streets, Lomasney Way/Nashua Street, Leverett Circle, City Square, and O'Brien Highway/Gilmore Bridge. In the PM peak hour, Keany Square, Sumner Tunnel/North Washington Street, and O'Brien Highway/Gilmore Bridge operate at LOS F with all designs. Traffic problems are experienced currently at most of these locations, as is documented in the 1991 FSEIS/R. Increased congestion at these intersections will result from projected land use changes and employment growth that are independent of the Project.

Beyond consideration of the number of LOS F intersections, closer examination of traffic operations at all 25 intersections shows that the alternatives result in improved traffic conditions on local and arterial streets, particularly in the downtown area and Charlestown, compared to Scheme Z. This is due in large measure to the inclusion of the northbound on-ramp at New Sudbury Street in the new alternatives. Intersections that have a better LOS with the new alternatives than with Scheme Z are as follows:

- Causeway Street/Surface Artery northbound (AM)
- Causeway Street/Merrimac Street/Lomasney Way (AM; PM--Non-River-Tunnel only)
- Surface Artery southbound/Valenti Way (AM and PM)
- Sumner Tunnel/North Washington Street (AM)
- New Chardon Street/Surface Artery southbound (AM)
- New Sudbury/Congress Streets (AM--Reduced River-Tunnel PM)
- State Street/Surface Artery southbound (AM--8.1D Mod 5 and Reduced River-Tunnel)
- Lomasney Way/Nashua Street (PM--Non-River-Tunnel only)
- Leverett Circle (PM--Reduced River-Tunnel only)
- City Square (PM--all new design alternatives, particularly Reduced River-Tunnel and Non-River-Tunnel)
- Rutherford Avenue/Gilmore Bridge--(AM and PM)

Among the above intersections, major improvements occur at Surface Artery southbound/Valenti Way, New Chardon Street/Surface Artery southbound, Rutherford Avenue/Gilmore Bridge, New Sudbury/Congress Streets, and City Square, for the time periods and with the three new design alternatives as noted. These improvements result from the inclusion of the New Sudbury Street on-ramp in the new designs. The Causeway Street/Merrimac Street/Lomasney Way intersection operates substantially better with the Non-River-Tunnel alternative than Alternative 8.1D Mod 5 or the Reduced River-Tunnel Alternative, because the Non-River-Tunnel design eliminates a northbound on-ramp from the vicinity of this intersection.

In contrast, there are five intersections where traffic conditions are worse with any of the new design alternatives than with Scheme Z; these are as follows:

- New Sudbury/Cross Streets, at the portal to the New Sudbury Street on-ramp
- State Street/Surface Artery southbound (PM only), again because of the proximity of the on-ramp
- Charles Circle eastbound (because of superior operations on Storrow Drive eastbound through Leverett Circle, with Scheme Z)
- Rutherford Avenue/BSG (due to the placement of ramps to I-93 northbound at this location)
- Cambridge/First Streets (PM, Reduced River-Tunnel only)

In every case except Charles Circle eastbound in the AM peak hour only, these intersections continue to operate with a satisfactory LOS, although operations are somewhat better with Scheme Z.

Generally, traffic operations on local and arterial streets are better with any of the new design alternatives than with Scheme Z, while none of the alternatives creates substantial traffic problems at any surface street location. Among the alternatives, the Non-River-Tunnel Alternative causes the fewest intersections to operate at LOS F.

4.1.3 Vehicle Miles/Hours Of Travel

Vehicle Miles of Travel (VMT) is a measure of the cumulative distance travelled by all vehicles in a designated area. Vehicle Hours of Travel (VHT) is a measure of the cumulative time travelled by all vehicles in a designated area, i.e., the time expended during the accumulation of VMT. The comparison of VMT and VHT for the alternatives provides an indication of the overall efficiency and quality of traffic operations, with lower VMT and VHT reflecting more direct routing and less traffic congestion.

All three new design alternatives reduce both VMT and VHT by approximately 1 to 2 percent, relative to Scheme Z, over the entire study area for the 1991 FSEIS/R (see Tables 4.5 and 4.6). Variations among the alternatives are less than 1 percent. For the areas closest to the Charles River crossing, including Beacon Hill, the Financial District, the North End, the North Station area, Charlestown, and Cambridge/Somerville, variations among all four designs, including Scheme Z, are less than 3 percent.

4.1.4 Truck Movements And Hazardous Cargo Routes

This section responds to an EOECA scope requirement for this DSEIS/R in the Secretary of Environmental Affairs Certificate on the NPC, that the surface route options available for hazardous cargo transportation be evaluated.

Truck movements are accommodated on all mainline tunnels, viaducts, and ramps of Scheme Z and the three design alternatives, with the exception of trucks carrying hazardous cargoes. It is MHD policy that hazardous cargo movements will be prohibited from all tunnel segments of the Central Artery. This is consistent with City of Boston regulations (see below) that place strict constraints on the surface and tunnel movements of vehicles carrying hazardous materials. No changes are expected to the existing primary hazardous cargo routes.

City Of Boston Regulations. On December 15, 1980, the City of Boston issued regulations for controlling the transportation of hazardous materials. These regulations were issued by the Fire Commissioner and the Commissioner of Health and Hospitals in compliance with Chapter 39 of the Ordinances of 1979 and under the authority granted by Massachusetts General Laws Chapters 111 and 148, and other applicable laws. These have been in effect since April 6, 1981. Title 720 CMR Section

Table 4.3

AM PEAK HOUR INTERSECTION OPERATIONS – YEAR 2010

Name/Approach	Approach Volumes (vph)		Approach Delay (sec/vch)		Volume to Capacity Ratios (v/c)		LOS	
	Scheme "Z"	8.1D Mod 5	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	8.1D Mod 5	Non – River Tunnel
DOWNTOWN/NORTH STA./BEACON HILL								
<u>Keaney Square</u>								
Commercial	WB	259	282	272	277	601	617	536
Causeway	EB	920	791	767	789	544	553	475
N Washington	NB	700	664	652	664	573	593	512
Charlestown Bridge	SB	2,890	3,105	3,110	3,092	212	221	190
Totals –		4,769	4,842	4,800	4,821	352	352	301
<u>Causeway/Surface NB</u>								
Causeway	EB	894	773	750	768	13	11	9
Causeway	WB	1,217	1,329	1,297	1,294	15	13	11
Surface Artery	NB	794	711	695	647	18	20	18
Totals –		2,904	2,814	2,743	2,708	15	14	12
<u>Causeway/Surface SB</u>								
Causeway	EB	923	799	757	775	5	9	6
Causeway	WB	1,952	1,999	1,952	1,900	5	3	3
MBTA Garage Exit	SB	243	116	113	139	28	30	31
Totals –		3,118	2,914	2,822	2,814	7	6	5
<u>Causeway/Merrimac/Lomasney</u>								
Stanford	EB	860	1,061	1,085	939	45	27	28
Causeway	WB	1,149	1,060	1,052	1,013	40	33	36
Merrimac	NB	887	551	578	507	54	37	42
Lomasney	SB	1,471	1,566	1,563	1,620	41	30	30
Totals –		4,366	4,238	4,279	4,078	44	31	33
<u>Surface SB/Valenti</u>								
N Washington	WB	2,420	1,604	1,620	1,604	68	11	10
Surface Artery	SB	515	623	558	576	88	30	30
Totals –		2,935	2,227	2,178	2,181	71	16	15
<u>Sumner Tunnel/N Washington</u>								
N Washington	NB	2,193	2,000	1,967	1,952	64	35	32
Sumner Tunnel	EB	459	482	486	475	91	63	61
Totals –		2,652	2,482	2,453	2,427	68	40	38
<u>New Chardon/Surface SB/Sumner</u>								
New Chardon	EB	1,051	964	936	959	17	21	20
Sumner Tunnel	WB	1,236	939	927	911	56	36	34
Surface Artery	SB	2,931	3,028	2,985	2,991	47	21	20
Totals –		5,218	4,931	4,849	4,860	43	24	22
<u>New Sudbury/Surface SB</u>								
New Sudbury	EB	897	1,223	1,281	1,281	4	4	3
Surface Artery	SB	299	326	276	329	27	27	28
Totals –		1,196	1,549	1,557	1,610	10	9	8
<u>New Sudbury/Cross/Sudbury On</u>								
New Sudbury	EB	373	706	703	773	27	26	26
Cross	NB	1,566	1,870	1,859	1,860	7	13	13
Totals –		1,940	2,576	2,562	2,633	11	16	16

Table 4.3 (continued)
AM PEAK HOUR INTERSECTION OPERATIONS – YEAR 2010

Name/Approach	Approach Volumes (vph)			Approach Delay (sec/veh)			Volume to Capacity Ratios (v/c)			LOS		
	Scheme "Z"	8.1D Mod 5	River Tunnel	Non- River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Non- River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Non- River Tunnel
DOWNTOWN/NORTH STA./BEACON HILL												
<u>New Chardon/Congress</u>												
New Chardon	2,045	1,880	1,842	1,854	307	220	209	210	1.45	1.35	1.34	1.34
Congress	1,119	1,126	1,108	1,051	272	186	178	186	0.50	0.49	0.48	0.46
Merrimac	1,004	970	975	1,000	314	227	217	217	1.45	1.35	1.34	1.34
Totals –	4,168	3,976	3,925	3,905	300	213	203	206				
<u>New Sudbury/Congress</u>												
New Sudbury	1,544	1,609	1,595	1,663	58	90	50	74	0.91	1.12	1.01	1.08
Congress	1,374	1,499	1,298	1,411	67	75	51	74	1.10	1.12	1.05	1.11
Congress	1,452	1,587	1,546	1,581	32	33	26	33	0.51	0.51	0.51	0.52
Totals –	4,370	4,695	4,439	4,656	52	66	42	60				
<u>State/Surface SB</u>												
State	403	347	346	363	56	45	48	48	0.60	0.59	0.61	0.59
Surface Artery	2,548	2,529	2,537	2,506	16	9	10	11	0.61	0.59	0.58	0.59
Totals –	2,951	2,876	2,883	2,869	21	13	15	15				
<u>State/Surface NB</u>												
State	381	381	381	382	15	16	16	16	0.62	0.64	0.64	0.64
Surface Artery	1,158	1,233	1,225	1,221	15	15	15	15	0.62	0.64	0.64	0.64
Totals –	1,539	1,614	1,606	1,604	15	15	15	15				
<u>Lomasney/Nashua</u>												
Martha Way	746	736	684	683	1000	597	365	286	1.43	0.73	1.10	1.08
Lomasney	1,059	1,016	1,121	731	9	279	187	11	0.58	1.33	1.21	0.47
Nashua	1,167	1,332	1,558	1,376	2446	742	656	170	0.57	1.74	1.68	0.74
North Station Garage	466	593	599	571	1565	452	397	424	2.00	0.81	0.68	1.43
Totals –	3,439	3,677	3,961	3,362	1255	538	434	200				
<u>Leverett Circle</u>												
Charles/Storrow	1,347	2,656	1,420	1,806	102	343	23	74	0.58	1.15	0.72	0.93
OFF from I-93 from the South	n/a	569	544	n/a	n/a	24	18	n/a	n/a	0.73	0.53	n/a
Nashua	1,780	1,998	1,848	2,466	23	132	107	165	0.77	0.86	0.94	1.26
Charles River Dam	1,591	1,674	1,676	1,642	122	410	105	160	1.21	1.54	1.18	1.27
Totals –	4,718	6,898	5,488	5,914	80	274	76	136				

Table 4.3 (continued)
AM PEAK HOUR INTERSECTION OPERATIONS – YEAR 2010

Name/Approach	Approach Volumes (vph)			Approach Delay (sec/veh)			Volume to Capacity Ratios (v/c)			LOS		
	Scheme "Z"	8.1D Mod 5	Non – River Tunnel	Scheme "Z"	8.1D Mod 5	Non – River Tunnel	Scheme "Z"	8.1D Mod 5	Non – River Tunnel	Scheme "Z"	8.1D Mod 5	Non – River Tunnel
BEACON HILL												
<u>Cambridge/Stamford</u>												
Cambridge	1,848	1,858	1,908	12	25	26	0.69	0.71	0.71	B	C	C
Cambridge	1,147	892	914	28	54	58	0.91	1.04	1.05	D	E	E
Stamford	631	633	620	28	48	51	0.64	0.53	0.53	D	E	D
Totals –	3,626	3,383	3,443	20	37	40				C	D	D
<u>Charles Circle Eastbound</u>												
Longfellow Bridge	756	656	672	51	86	104	1.02	1.11	1.16	E	F	F
Storrow Dr. EB Off Ramp	1,682	2,014	2,105	33	65	84	1.02	1.11	1.16	D	F	F
Storrow Dr. WB Off Ramp	851	868	882	49	82	100	1.02	1.11	1.16	E	F	F
Totals –	3,289	3,538	3,649	41	73	92				E	F	F
<u>Charles Circle Westbound</u>												
Cambridge	944	773	738	5	8	8	0.25	0.24	0.24	A	B	B
Charles	665	962	980	15	11	10	0.29	0.29	0.28	B	B	B
Totals –	1,610	1,735	1,718	9	10	10				B	B	B
CHARLESTOWN												
<u>City Square</u>												
I-93 C-L Exit	1,743	n/a	n/a	1038	n/a	n/a	1.92	n/a	n/a	F	n/a	n/a
Chelsea	1,878	1,787	1,755	641	165	133	1.55	0.92	0.99	F	F	F
Charlestown Br	1,852	1,640	1,608	19	12	9	0.78	0.63	0.52	C	B	B
Rutherford	2,976	3,132	3,071	731	192	171	1.15	0.97	0.91	F	F	F
Totals –	8,449	6,560	6,434	616	140	119				F	F	F
<u>Rutherford/I-93 Connector</u>												
Connector	496	723	660	37	63	54	0.76	0.88	0.87	D	F	F
Rutherford	2,353	1,000	960	8	28	25	0.53	0.24	0.22	B	D	D
Rutherford	3,241	3,299	3,209	15	45	33	0.83	1.00	0.96	B	E	E
Totals –	6,089	5,023	4,829	14	44	34				B	E	E
<u>Rutherford/Gilmore</u>												
Gilmore	1,096	962	956	42	15	14	0.74	0.64	0.61	E	B	B
Austin	366	300	225	110	38	39	1.14	0.85	0.82	F	D	D
Rutherford	1,244	863	773	80	11	8	1.14	0.82	0.72	F	B	B
Rutherford	950	1,526	1,596	5	9	7	0.43	0.69	0.71	B	B	B
Totals –	3,657	3,651	3,550	52	14	12				E	B	B
<u>Rutherford/C-L @ Bunker Hill Comm. Coll.</u>												
C-L OFF @ B.H. Comm. Coll.	n/a	1,705	1,788	n/a	13	29	n/a	0.86	0.75	n/a	B	D
Rutherford	n/a	612	604	n/a	3	7	n/a	0.14	0.18	n/a	A	B
Rutherford	n/a	3,483	3,479	n/a	7	27	n/a	0.80	1.02	n/a	B	D
Totals –	n/a	5,799	5,871	n/a	8	25				n/a	B	D



Table 4.3 (continued)
AM PEAK HOUR INTERSECTION OPERATIONS – YEAR 2010

Name/Approach	Approach Volumes (vph)			Approach Delay (sec/veh)			Volume to Capacity Ratios (v/c)			LOS		
	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel
CHARLESTOWN												
<u>I-93/U.S. 1/Connector</u>												
Connector	n/a	30	30	n/a	14	14	n/a	0.08	0.08	n/a	B	B
Connector	n/a	698	664	n/a	22	20	n/a	0.65	0.60	n/a	C	C
Ramp to/from U.S. 1	n/a	800	734	n/a	14	12	n/a	0.34	0.32	n/a	B	B
Ramp to/from I-93	n/a	454	457	n/a	7	7	n/a	0.18	0.18	n/a	B	B
Totals –	n/a	1982	1885	n/a	15	14	n/a			n/a	C	B
CITY OF CAMBRIDGE												
<u>O'Brien/Gilmore Bridge</u>												
O'Brien	1,596	1,536	1,530	259	333	316	1.13	1.09	1.10	F	F	F
Charles River Dam	764	709	711	283	338	343	0.70	1.26	1.32	F	F	F
Gilmore Bridge	2,430	2,496	2,483	188	208	204	1.19	1.15	1.12	F	F	F
Edwin Land Blvd.	1,216	1,247	1,248	440	547	538	1.56	1.64	1.63	F	F	F
Totals –	6,006	5,988	5,972	271	327	320				F	F	F
<u>Lechmere Square</u>												
O'Brien	1,784	1,697	1,729	18	18	18	0.74	0.74	0.29	C	C	C
O'Brien	1,090	1,058	1,062	22	22	21	0.58	0.56	0.56	C	C	C
Cambridge	416	405	399	25	24	24	0.31	0.30	0.30	C	C	C
Totals –	3,291	3,160	3,190	20	20	19				C	C	C
<u>Cambridge/First</u>												
Cambridge	357	336	336	23	23	23	0.41	0.42	0.42	C	C	C
Cambridge	853	867	867	7	7	15	0.44	0.44	0.44	B	B	B
First	206	201	201	24	24	15	0.34	0.33	0.33	C	C	C
Totals –	1,416	1,404	1,404	13	13	17				B	B	B

Table 4.4

PM PEAK HOUR INTERSECTION OPERATIONS – YEAR 2010

Name/Approach	Approach Volumes (vph)			Approach Delay (sec/veh)			Volume to Capacity Ratios (v/c)			LOS		
	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel
DOWNTOWN/NORTH STA./BEACON HILL												
<u>Keaney Square</u>												
Commercial	712	598	561	570	594	172	195	309	1.67	1.27	1.30	1.43
Causeway	1,162	972	939	1,020	540	171	214	299	1.48	1.22	1.29	1.37
N Washington	1,214	846	825	911	587	167	189	302	1.67	1.27	1.30	1.43
Charlestown Bridge	1,510	1,525	1,718	1,683	306	121	95	131	1.10	1.11	1.07	1.02
Totals –	4,599	3,941	4,043	4,185	486	151	156	234				
<u>Causeway/Surface NB</u>												
Causeway	906	783	836	923	13	13	10	11	0.47	0.41	0.37	0.43
Causeway	880	778	848	802	13	13	10	11	0.45	0.41	0.38	0.37
Surface Artery	863	553	522	485	12	15	15	18	0.41	0.31	0.28	0.31
Totals –	2,650	2,114	2,206	2,210	13	14	11	12				
<u>Causeway/Surface SB</u>												
Causeway	1,394	1,247	1,199	1,348	9	6	6	6	0.59	0.42	0.42	0.45
Causeway	1,547	1,288	1,323	1,250	7	6	6	6	0.48	0.39	0.40	0.38
MBTA Garage Exit	519	346	337	394	28	24	24	25	0.79	0.56	0.55	0.64
Totals –	3,460	2,882	2,859	2,993	11	8	8	9				
<u>Causeway/Merrimac/Lomasney</u>												
Stanford	933	1,249	1,219	902	36	59	44	22	0.78	0.42	0.41	0.52
Causeway	956	796	781	729	23	96	93	21	0.72	1.12	1.10	0.60
Merrimac	792	456	479	355	30	94	69	38	0.72	1.08	0.97	0.77
Lomasney	1,442	1,518	1,519	1,564	31	55	75	20	0.83	0.85	0.92	0.67
Totals –	4,122	4,019	3,997	3,549	30	69	69	23				
<u>Surface SB/Valenti</u>												
N Washington	1,767	1,240	1,286	1,202	25	10	11	12	0.98	0.69	0.71	0.71
Surface Artery	1,014	723	735	870	38	24	24	22	0.98	0.69	0.71	0.71
Totals –	2,781	1,964	2,021	2,073	30	15	16	17				
<u>Sumner Tunnel/N Washington</u>												
N Washington	2,193	2,284	2,260	2,187	59	82	69	57	1.11	1.16	1.13	1.10
Sumner Tunnel	459	520	486	463	87	98	90	83	0.73	0.85	0.84	0.79
Totals –	2,652	2,804	2,746	2,649	64	85	72	61				
<u>New Chardon/Surface SB/Sumner</u>												
New Chardon	1,360	1,401	1,330	1,371	26	24	24	24	0.92	0.89	0.88	0.90
Sumner Tunnel	792	560	557	563	21	17	18	17	0.77	0.51	0.53	0.52
Surface Artery	2,766	2,584	2,650	2,657	17	17	16	17	0.92	0.89	0.88	0.90
Totals –	4,919	4,545	4,537	4,591	20	19	19	19				
<u>New Sudbury/Surface SB</u>												
New Sudbury	1,124	1,187	1,313	1,259	3	5	4	5	0.31	0.38	0.40	0.42
Surface Artery	201	356	243	380	30	25	26	23	0.56	0.47	0.40	0.43
Totals –	1,325	1,544	1,556	1,639	7	9	7	10				
<u>New Sudbury/Cross/Sudbury On</u>												
New Sudbury	515	951	1,039	1,130	30	45	53	60	0.74	0.99	1.03	1.05
Cross	2,066	2,335	2,338	2,300	10	25	33	42	0.74	0.99	1.03	1.05
Totals –	2,581	3,286	3,377	3,431	13	30	39	48				

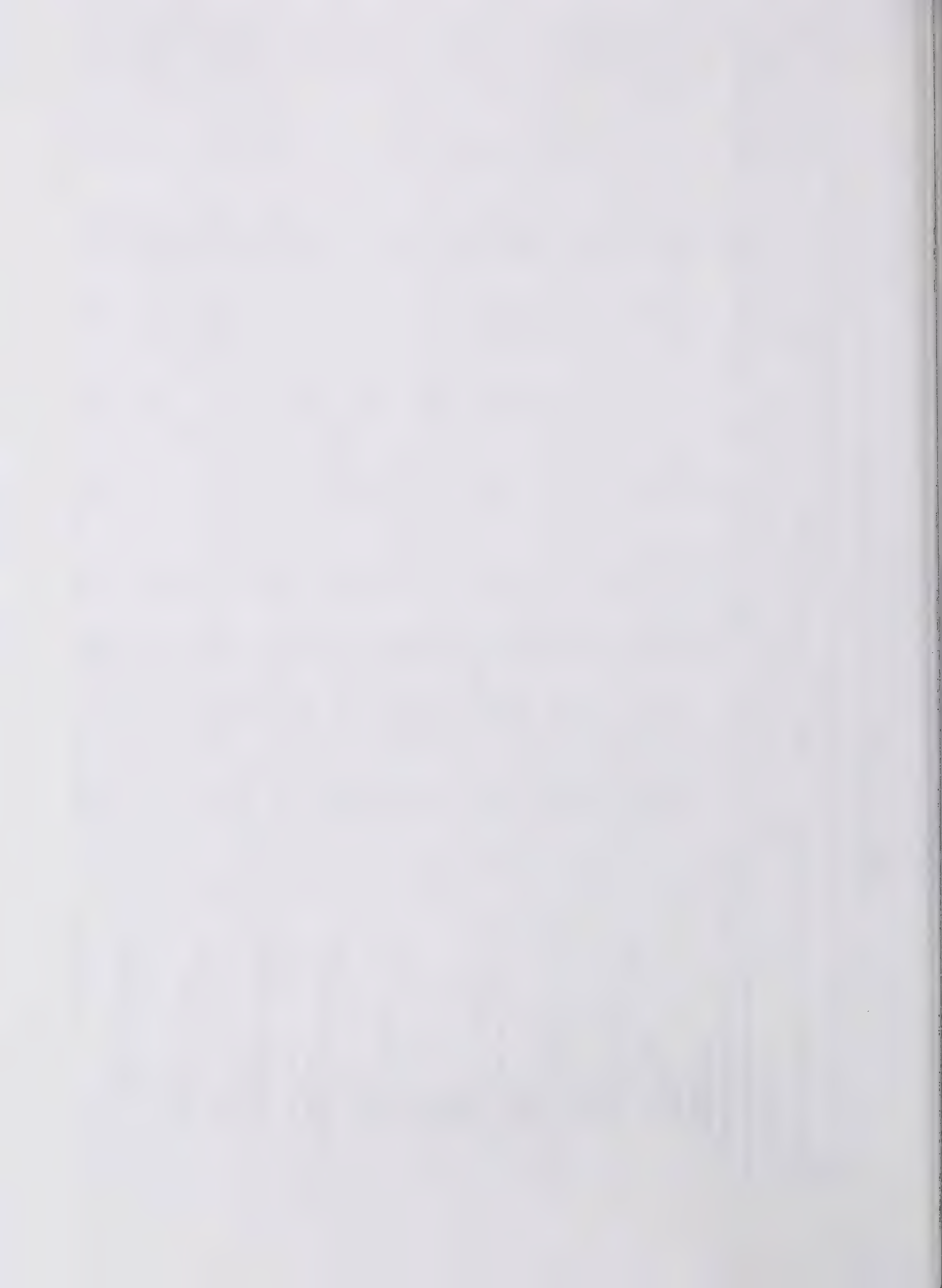


Table 4.4 (continued)
PM PEAK HOUR INTERSECTION OPERATIONS – YEAR 2010

Name/Approach	Approach Volumes (vph)			Approach Delay (sec/veh)			Volume to Capacity Ratios (v/c)			LOS		
	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel
DOWNTOWN/NORTH STA./BEACON HILL												
New Chardon/Congress												
New Chardon	1,722	1,383	1,389	1,378	15	9	9	9	11	B	B	B
Congress	752	425	484	385	21	21	21	21	20	C	C	C
Merrimac	602	383	452	570	29	26	25	23	23	D	D	C
Totals –	3,076	2,191	2,324	2,333	19	14	15	15	15	C	B	C
New Sudbury/Congress												
New Sudbury	1,780	1,819	1,803	1,776	80	32	25	39	39	F	D	D
Congress	1,097	1,008	820	986	98	40	33	48	48	F	D	E
Congress	856	742	818	961	67	33	24	33	33	F	D	D
Totals –	3,732	3,569	3,441	3,723	82	35	27	40	40	F	D	D
State/Surface SB												
State	258	230	228	221	32	32	32	32	32	D	D	D
Surface Artery	2,061	1,979	2,002	2,009	3	3	3	3	3	A	A	A
Totals –	2,319	2,209	2,230	2,230	7	6	6	6	6	B	B	B
State/Surface NB												
State	451	451	451	451	24	27	27	27	27	C	D	D
Surface Artery	1,754	1,851	1,861	1,849	17	17	17	17	17	C	C	C
Totals –	2,205	2,302	2,312	2,299	18	19	19	19	19	C	C	C
Lomasney/Nashua												
Martha Way	477	505	507	401	616	825	754	76	76	F	F	F
Lomasney	1,257	1,712	1,661	751	10	930	1132	15	15	B	F	B
Nashua	729	996	1,084	970	241	852	1094	28	28	F	F	D
North Station Garage	648	826	838	779	583	595	737	53	53	F	F	E
Totals –	3,111	4,040	4,091	2,901	272	830	995	38	38	F	F	D
Leverett Circle												
Charles/Storrow	1,865	2,495	1,606	2,209	134	491	43	233	233	F	E	F
OFF from I-93 from the South	n/a	359	385	n/a	n/a	21	14	n/a	n/a	n/a	C	n/a
Nashua	1956	1803	1389	1949	131	199	41	106	106	F	F	F
Charles River Dam	1887	1813	1668	1718	252	542	39	288	288	F	F	D
Totals –	5709	6470	5048	5875	174	401	39	208	208	F	F	F

Table 4.4 (continued)

PM PEAK HOUR INTERSECTION OPERATIONS – YEAR 2010

Name/Approach	Approach Volumes (vph)			Approach Delay (sec/veh)			Volume to Capacity Ratios (v/c)			LOS		
	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel
BEACON HILL												
Cambridge/Staniford												
EB	1348	1395	1350	1290	9	12	15	11	0.49	0.53	0.49	0.47
WB	1376	1099	1086	986	22	27	31	27	0.86	0.90	0.94	0.87
SB	575	530	535	579	27	30	33	26	0.70	0.51	0.51	0.54
Totals –	3299	3024	2971	2855	17	21	24	20				
Charles Circle Eastbound												
Longfellow Bridge	1468	1397	1424	1442	22	34	35	42	0.88	0.98	0.99	1.02
Storrow Dr. EB Off Ramp	939	1280	1249	1332	25	32	34	40	0.88	0.98	0.99	1.02
Storrow Dr. WB Off Ramp	714	695	740	739	32	45	45	53	0.88	0.98	0.99	1.02
Totals –	3121	3371	3413	3513	26	35	37	44				
Charles Circle Westbound												
Cambridge	1361	1316	1259	1249	6	7	7	8	0.36	0.37	0.36	0.38
Charles	971	1103	1126	1284	14	13	13	12	0.39	0.39	0.38	0.40
Totals –	2332	2419	2385	2533	9	10	10	10				
CHARLESTOWN												
City Square												
I-93 C-L Exit	1268	n/a	n/a	n/a	305	n/a	n/a	n/a	1.44	n/a	n/a	n/a
Chelsea	1370	1433	1417	1362	252	47	31	34	1.22	0.85	0.82	0.83
Charlestown Br	2775	2248	2218	2342	94	12	12	7	1.09	0.65	0.66	0.57
Rutherford	2395	2533	2582	2564	212	38	19	21	0.87	0.76	0.79	0.79
Totals –	7809	6213	6217	6267	191	31	19	19				
Rutherford/I-93 Connector												
Connector	420	349	397	403	81	104	92	122	0.71	0.78	0.80	0.85
Rutherford	2506	1778	1719	1841	16	28	27	44	0.53	0.35	0.34	0.35
Rutherford	3056	3230	3183	3104	26	30	31	56	0.88	0.88	0.94	1.07
Totals –	5982	5357	5299	5348	26	34	34	57				
Rutherford/Gilmore												
Gilmore	1857	1610	1609	1547	60	15	13	12	1.00	0.85	0.83	0.77
Austin	257	190	133	133	149	49	53	40	1.20	0.89	0.88	0.77
Rutherford	1193	790	822	784	113	12	11	12	1.20	0.79	0.74	0.75
Rutherford	614	1011	872	953	4	9	7	7	0.28	0.46	0.39	0.44
Totals –	3921	3601	3437	3416	74	14	12	12				
Rutherford/C-L @ Bunker Hill Comm. Coll.												
C-L OFF @ B.H. Comm. Coll.	n/a	1985	1881	2051	n/a	16	20	20	n/a	0.71	0.66	0.72
Rutherford	n/a	1288	1189	1205	n/a	13	14	14	n/a	0.49	0.47	0.48
Rutherford	n/a	2395	2414	2422	n/a	20	23	24	n/a	0.91	0.95	0.96
Totals –	n/a	5668	5485	5679	n/a	17	20	20				

Table 4.4 (continued)
PM PEAK HOUR INTERSECTION OPERATIONS – YEAR 2010

Name/Approach	Approach Volumes (vph)			Approach Delay (sec/veh)			Volume to Capacity Ratios (v/c)			LOS		
	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel	Scheme "Z"	8.1D Mod 5	River Tunnel
CHARLESTOWN												
<u>I-93/U.S. 1/Connector</u>												
Connector	n/a	30	30	n/a	5	5	n/a	0.05	0.05	n/a	A	A
Connector	n/a	1223	1177	n/a	11	11	n/a	0.66	0.64	n/a	B	B
Ramp to/from U.S. 1	n/a	486	531	n/a	22	24	n/a	0.45	0.47	n/a	C	D
Ramp to/from I-93	n/a	849	849	n/a	25	23	n/a	0.64	0.61	n/a	C	C
Totals –	n/a	2588	2587	n/a	18	18	n/a			n/a	C	C
CITY OF CAMBRIDGE												
<u>O'Brien/Gilmore</u>												
O'Brien	1651	1713	1719	330	345	292	0.98	1.00	0.99	F	F	F
Charles River Dam	1166	545	874	199	101	231	0.89	0.44	0.69	F	F	F
Gilmore Bridge	2590	3066	2577	285	338	212	1.40	1.46	0.27	F	F	F
Edwin Land Blvd.	978	873	805	355	378	377	1.49	1.50	1.50	F	F	F
Totals –	6386	6197	5975	292	236	261				F	F	F
<u>Lechmere Square</u>												
O'Brien	951	924	957	23	20	22	0.50	0.54	0.49	C	C	C
O'Brien	1334	1332	1344	27	24	27	0.79	0.74	0.79	D	C	C
Cambridge	1218	1232	1286	15	16	16	0.68	0.75	0.72	C	C	C
Totals –	3503	3488	3587	22	20	21				C	C	C
<u>Cambridge/First</u>												
Cambridge	840	825	813	27	28	38	0.83	0.85	0.95	D	D	D
Cambridge	914	887	925	22	21	31	0.78	0.74	0.84	C	D	C
First	584	572	632	22	23	32	0.49	0.48	0.49	C	D	C
Totals –	2339	2284	2370	24	24	34				C	C	C

Table 4.5

VEHICLE MILES OF TRAVEL (VMT) – YEAR 2010

Districts		Scheme "Z"		8.1D Mod 5		River Tunnel		Non – River Tunnel	
No.	Name	Daily	Annual	Daily	Annual	Daily	Annual	Daily	Annual
TOTALS – ALL ROADWAYS									
1	Government Center	59,083	19,556,473	55,010	18,208,310	55,754	18,454,574	55,593	18,401,283
2	Financial District	53,368	17,664,808	51,316	16,985,596	51,614	17,084,234	51,665	17,101,115
3	North End	201,602	66,730,262	224,530	74,319,430	219,264	72,576,384	220,802	73,085,462
4	North Station	244,600	80,962,600	266,541	88,225,071	236,664	78,335,784	255,499	84,570,169
5	West End	92,920	30,756,520	90,267	29,878,377	94,995	31,443,345	87,040	28,810,240
6	Beacon Hill	122,154	40,432,974	118,902	39,356,562	120,015	39,724,965	119,254	39,473,074
22	Charlestown	756,208	250,304,848	673,543	222,942,733	698,284	231,132,004	710,455	235,160,605
23	Navy Yard	28,616	9,471,896	26,173	8,663,263	25,738	8,519,278	26,077	8,631,487
24	Cambridge/Somerville	507,732	168,059,292	503,619	166,697,889	502,722	166,400,982	504,218	166,896,158
Subtotals: ANOC districts		2,066,283	683,939,673	2,009,901	665,277,231	2,005,050	663,671,550	2,030,603	672,129,593
Rest of Project Area		3,442,737	1,139,545,947	3,415,102	1,130,398,762	3,433,864	1,136,608,984	3,433,850	1,136,604,350
Total: Projectwide		5,509,020	1,823,485,620	5,425,003	1,795,675,993	5,438,914	1,800,280,534	5,464,453	1,808,733,943

Table 4.6

VEHICLE HOURS OF TRAVEL (VHT) – YEAR 2010

Districts		Scheme "Z"		8.1D Mod 5		River Tunnel		Non – River Tunnel	
No.	Name	Daily	Annual	Daily	Annual	Daily	Annual	Daily	Annual
TOTALS – ALL ROADWAYS									
1	Government Center	6,039	1,998,909	5,438	1,799,978	5,568	1,843,008	5,551	1,837,381
2	Financial District	10,935	3,619,485	10,088	3,339,128	10,199	3,375,869	10,336	3,421,216
3	North End	10,108	3,345,748	11,017	3,646,627	10,882	3,601,942	10,879	3,600,949
4	North Station	11,049	3,657,219	10,494	3,473,514	9,971	3,300,401	12,346	4,086,526
5	West End	6,157	2,037,967	6,723	2,225,313	6,322	2,092,582	6,009	1,988,979
6	Beacon Hill	13,672	4,525,432	13,351	4,419,181	13,254	4,387,074	13,052	4,320,212
22	Charlestown	30,487	10,091,197	30,297	10,028,307	32,241	10,671,771	32,330	10,701,230
23	Navy Yard	1,439	476,309	1,292	427,652	1,265	418,715	1,271	420,701
24	Cambridge/Somerville	74,505	24,661,155	72,418	23,970,358	73,614	24,366,234	74,089	24,523,459
Subtotals: ANOC districts		164,391	54,413,421	161,118	53,330,058	163,316	54,057,596	165,863	54,900,653
Rest of Project Area		238,763	79,030,553	231,961	76,779,091	234,352	77,570,512	234,012	77,457,972
Total: Projectwide		403,154	133,443,974	393,079	130,109,149	397,668	131,628,108	399,875	132,358,625

8 has been adopted and incorporated in the City regulations as have, with some modifications, Federal Motor Carrier Safety Regulations 49 CFR 397.5, 397.7, 397.9, and 397.21.

In particular concerning the routing of hazardous cargo, 49 CFR 397.9(a) states that unless there is no practicable alternative, a motor vehicle containing hazardous materials must be operated over routes that do not go through or near heavily populated areas, places where crowds are assembled, tunnels, narrow streets, or alleys. It further states that operating convenience is not a basis for determining whether it is practicable to operate a motor vehicle in accordance with this regulation. Supplementing these regulations, the City of Boston has set forth additional regulations for certain types and quantities of hazardous materials as defined in Sections 4.01 and 4.02 of the City of Boston regulations.

City of Boston regulations state that use of City streets for the transportation of materials specified in Section 4.01 is prohibited where there is neither a point of origin or destination within the City. Further, they also state that use of City streets in the downtown area for transportation of materials specified in Sections 4.01 and 4.02 is prohibited during the hours between 6:00 AM and 8:00 PM daily, except Saturdays, Sundays, and holidays. The downtown area is defined as the area bounded by and including Massachusetts Avenue at the entrance ramp to the Southeast Expressway, the Southeast Expressway to the Kneeland Street ramp, along Kneeland Street to Atlantic Avenue, then along a line following the waterfront to the Charles River, along the Charles River to Massachusetts Avenue, and along Massachusetts Avenue to the Massachusetts Avenue entrance ramp to the Southeast Expressway. Exemptions to these regulations may be granted in accordance with a permit issued by the Fire Commissioner. However, regardless of any permits, the use of City streets in the downtown area is strictly prohibited between the hours of 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM.

Primary Cargo Routes. In September 1986, in accordance with the recently enacted Title III of the Superfund Amendments and Reauthorization Act of 1986, and in accordance with its provisions, the City of Boston Local Emergency Planning Committee (Boston LEPC), co-chaired by the Boston Fire Department (BFD) and the Mayor's Office, designated a system of primary hazardous cargo routes in the City of Boston. In the downtown area, there are two routes designated primary hazardous cargo routes. The first is I-93 to the Kneeland Street off-ramp, then Kneeland Street to Atlantic Avenue, Atlantic Avenue to Commercial Street, and Commercial Street to the Charlestown bridge. The second is the Massachusetts Avenue connector, then Massachusetts Avenue to Commonwealth Avenue. In South Boston, the primary hazardous cargo route is Summer Street, East First Street, and L Street. In East Boston the primary hazardous cargo routes include Route 1A (not including the Sumner or Callahan Tunnels) and Chelsea Street. In Charlestown, the primary hazardous cargo route includes Rutherford Avenue and Constitution Road. Hazardous cargoes also are transported on the Expressway system on at-grade and elevated segments of I-93, as well as on the Tobin Bridge.

Project Impacts To The Primary Hazardous Cargo Route System. It is not the intent or purpose of this document to designate routes. Rather, the purpose of this document is to describe accurately the impacts to the primary hazardous cargo route system of the possible full-build street and highway networks of the different river crossing options so that the Boston LEPC can take action as it deems necessary. When construction of the entire Project is complete, all of the existing primary hazardous cargo routes as designated by the Boston LEPC that are within the Project limits will be able to be used as they are today. In the downtown area, both the Kneeland Street/Atlantic Avenue/Commercial Street/Charlestown bridge and the Massachusetts Avenue connector/Massachusetts Avenue routes will be available for use the same as now. On these two routes there will be new and improved systems of ramps and other roadways, but all of the existing connections will remain intact. The primary hazardous cargo routes in South Boston and East Boston will remain intact and usable as they are today. The primary hazardous cargo route system under full-build conditions is illustrated in Figure 4.15.

The authority to designate hazardous cargo routes in the City of Boston rests solely with the Boston LEPC.

Connections To CANA Tunnels. Hazardous cargo movements will be prohibited from all tunnel segments of the Central Artery. There is an ongoing discussion between MHD and BFD regarding the use by hazardous cargo vehicles of the tunnels being constructed as part of the CANA project, which is not part of this Project nor under its purview. The resolution of this discussion will indicate whether or not a non-tunnel replacement route between Leverett Circle and Route 1/Tobin Bridge will need to be submitted to the Boston LEPC for approval.

The design alternatives for the Charles River crossing differ with respect to their impact on hazardous cargo route connections to the CANA tunnels. The tunnels will link I-93 northbound and Leverett Circle/Storrow Drive with Route 1/Tobin Bridge. Differences among the four designs are discussed below in greater detail.

Alternative 8.1D Mod 5 And Reduced River-Tunnel Alternative: Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative take two moves that are on viaducts in Scheme Z and place them in tunnels. These moves, which are not part of the primary hazardous cargo route system, are between Leverett Circle (and its connections to Charles Street Extension and O'Brien Highway) and I-93 northbound, and between Leverett Circle and Route 1/Tobin Bridge. Hazardous cargoes are prohibited from these tunnel segments. The I-93 southbound to Leverett Circle movement remains on viaduct as in Scheme Z.

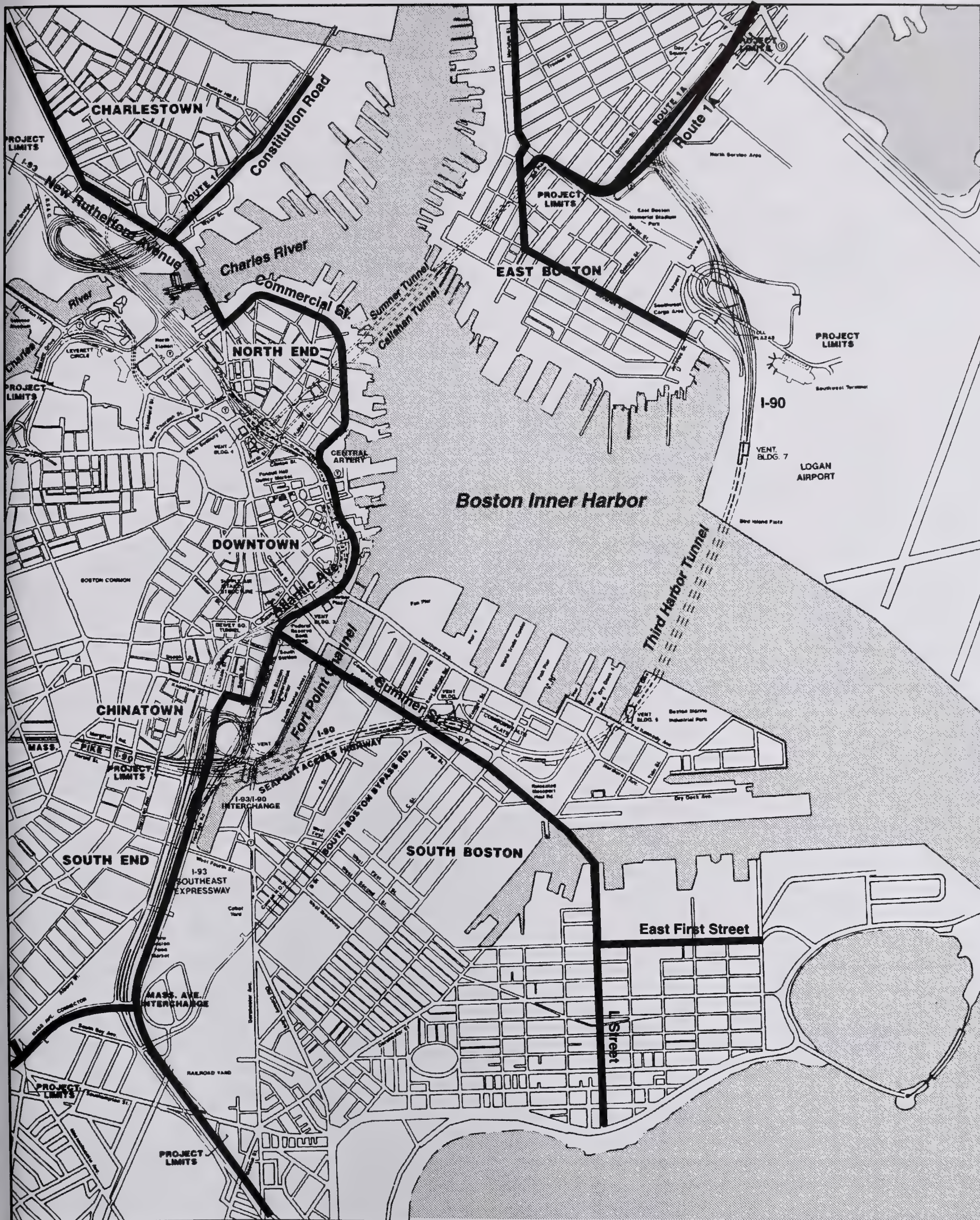
Nonetheless, for Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative, it is possible to achieve connections that do not travel through a tunnel segment, even if the two movements between Leverett Circle and I-93 northbound and between Leverett Circle and Route 1/Tobin Bridge are placed in tunnels. A possible connection for northbound trucks from Leverett Circle either to I-93 northbound or to Route 1/Tobin Bridge northbound is rebuilt Martha Road/Nashua Street and Causeway Street, connecting to the primary hazardous cargo route at the Charlestown bridge. Since these roads are not part of the primary hazardous cargo route system, Boston LEPC approval is required for their use.

Non-River-Tunnel Alternative And Scheme Z: For the Non-River-Tunnel Alternative, connections to the primary hazardous cargo route system in downtown Boston are identical to Scheme Z. Expressway access from Leverett Circle to I-93 northbound and to Route 1/Tobin Bridge northbound via viaduct connections is also possible, as under existing conditions. In the same manner as the connections described under the Reduced River-Tunnel Alternative, Boston LEPC approval is required for their use, since these roads are not part of the primary hazardous cargo route system.

4.1.5 Safety

Accident rates were forecast for each of the four Charles River crossing designs, using formulas based on national statistics and local conditions. These rates are a function of the following factors: type of roadway facility; vehicular volume; number of lanes; frequency and length of weaving sections; vertical and horizontal alignment; presence of diverge and merge points; and whether or not a roadway section is in tunnel. (The estimated number of annual accidents and accident rates per million VMT are shown in Table 4.7 for each of the design alternatives.)

Alternative 8.1D Mod 5 has the highest accident rate, at 5.84 per million VMT. This alternative also is projected to have the highest number of annual accidents and highest VMT. The reason for the high accident rate is the adverse curvature in the eastbound direction and long total length of tunnel section. Scheme Z has the lowest accident rate, at 4.89 per million VMT, and the lowest number of annual



FIGURE

4.15

Primary Hazardous Cargo Route System: All Designs

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 400 800 1600 2400 FEET



Table 4.7

ESTIMATED ANNUAL ACCIDENTS FOR MAJOR FREEWAY SECTIONS – YEAR 2010

Section/Alternative	Annual Vehicle Miles Traveled (VMT) (millions)	Total Estimated Accidents	Accidents Rate (accidents/million VMT)
Northbound:			
Scheme "Z"	53.024	242	4.56
8.1D Mod 5	58.957	246	4.17
River Tunnel	54.616	250	4.58
Non-River Tunnel	56.088	261	4.65
Southbound:			
Scheme "Z"	41.427	188	4.54
8.1D Mod 5	38.129	148	3.88
River Tunnel	38.073	157	4.12
Non-River Tunnel	37.479	143	3.82
Eastbound:			
Scheme "Z"	18.172	103	5.67
8.1D Mod 5	14.651	256	17.47
River Tunnel	7.989	111	13.89
Non-River Tunnel	16.923	129	7.62
Westbound:			
Scheme "Z"	16.948	100	5.90
8.1D Mod 5	20.260	121	5.97
River Tunnel	19.716	153	7.76
Non-River Tunnel	18.709	143	7.64
Total:			
Scheme "Z"	129.571	633	4.89
8.1D Mod 5	131.997	771	5.84
River Tunnel	120.394	671	5.57
Non-River Tunnel	129.199	676	5.23

Northbound = (Mainline NB from Essex/Northern On-Ramp to Sullivan Square)
 Southbound = (Mainline SB from Sullivan Square to Sudbury On-Ramp)
 Eastbound = (Storrow Drive EB from Blossom Street to Tobin Bridge at End of CANA Tunnel)
 Westbound = (Tobin Bridge WB from Start of CANA Tunnel to Storrow Drive at Blossom Street)

accidents, because the length of highway in tunnel is shortest. The Non-River-Tunnel Alternative has the second-lowest accident rate and number of total accidents, primarily because the length of tunnel section is less than with 8.1D Mod 5 or the Reduced River-Tunnel Alternative.

The length of tunnel sections greatly affects projections of accident rates for alternatives because, generally, the accident rate in tunnel sections is twice that experienced on open sections of highway. The design of the Project's tunnel sections reduces the effect of confined geometry through the inclusion of sight shelves on curves to increase stopping sight distance, increased lighting levels to improve visibility, and an arrangement of ceiling tiles and lighting fixtures to reflect travel lane patterns below. These elements will enhance driver perception, guidance, response, and decision-making, which should reduce accident frequency.

4.1.6 HOV Operations

This section addresses the impacts of the alternatives on HOV travel conditions. Operating characteristics are described for an HOV facility included in the three alternatives to Scheme Z. In addition, several issues are discussed in response to additional specific requirements of the EOE A Scope for this DSEIS/R, as follows:

- the inclusion of a PM peak northbound HOV lane
- integration of HOV planning within the Project limits with HOV planning for I-93 to the north of the Project limits
- provision of priority bus access from the HOV lane to Haymarket or another downtown terminal

4.1.6(a) Southbound HOV Lane

The three new design alternatives provide for a southbound HOV lane on the I-93 mainline, while Scheme Z as designed cannot accommodate a mainline HOV lane. The HOV lane incorporated in the new design alternatives extends between Sullivan Square and the Charles River bridge, a distance of approximately 1 mile, in approximately the same configuration as the existing I-93 HOV lane. A barrier or raised median such as that currently in use for the existing southbound HOV lane separates the lane from general-purpose traffic. The lane terminates and joins the general-purpose lanes just prior to the bridge over the Charles River, to allow adequate weaving distances to downtown exits.

With the three new design alternatives, substantial HOV volumes use both the parallel connector viaduct (to Storrow Drive, Nashua Street, Tobin Bridge, and Charlestown) and the I-93 mainline. Traffic flow on the connector is substantially below capacity for both HOVs and general-purpose traffic. The connector serves as the primary bus route to downtown Boston. Average operating speed in the dedicated mainline HOV lane is 35 mph, since it bypasses the capacity constraint at the merger of the Tobin Bridge on-ramps with the I-93 southbound mainline.

The southbound mainline HOV lane carries approximately 38,970 people in 15,000 vehicles per day with each of the alternatives, for an average vehicle occupancy rate of 2.6 persons per vehicle. HOVs constitute 25 percent of all vehicles on the segment of I-93 between Sullivan Square and the Charles River bridge, but carry 46 percent of the total number of people travelling in these vehicles. The HOV lane carries approximately 920 and 850-870 vehicles in the AM and PM peak hours, respectively. Currently, MHD has not determined whether the lane will be operated in the PM peak hour. This decision depends in part upon compatibility with a potential contraflow lane that has been proposed for I-93 to the north of the Project limits. (A contraflow lane is borrowed from the off-peak direction general-purpose lanes for HOV use.) The projected level of use exceeds the customary 800-vehicle per peak hour minimum volume threshold for a dedicated HOV lane.

Extension Of The Southbound HOV Lane: In the report, *High-Occupancy Vehicle Feasibility Study*, released in December 1992, MHD recommended northward extension of the existing southbound HOV lane by 0.8 mile, to the Sullivan Square off-ramp, as a short-range measure that could be implemented before completion of the Charles River crossing. Assuming that this extension would be replaced by a contraflow lane upon completion of the Charles River crossing, as also is recommended in the above report, the short-range recommendation would have no bearing on the HOV lane included in the three alternatives. This southbound HOV lane could be extended northward, however, if it is decided to retain the short-range HOV configuration for a longer period of time.

4.1.6(b) Northbound HOV Operations

Neither Scheme Z nor the three new alternatives includes a dedicated northbound HOV lane within the Project limits. Both civil engineering geometric constraints and the absence of substantial travel time benefits for HOVs are the principal factors that have governed the design treatment of northbound HOV operations. A northbound HOV lane would provide minimal travel time savings for HOVs, and therefore would not increase HOV use. Whereas a southbound HOV lane has been a feature of the crossing since the 1991 FSEIS/R, a separate northbound HOV lane has never been an element of the Project design.

Design Issues. The basic design constraint in providing a northbound HOV lane is integrating the lane entrance with I-93 mainline entrance and exit ramps. Each of the four designs includes general-purpose entrance and/or exit ramps on both the left and right sides of the I-93 mainline, on the segment of the mainline to the north of the Charles River bridge, as described more fully below.

Scheme Z: A two-lane, right-sided exit ramp to the Tobin Bridge and City Square is located within 200 feet of the north bank of the Charles River, after which the mainline merges on the right with a Tobin Bridge/City Square entrance ramp. Another 1,000 feet to the north, the mainline merges with a left-sided entrance ramp from Storrow Drive/Leverett Circle.

Alternative 8.1D Mod 5: A right-sided entrance ramp to Rutherford Avenue north of the Charles River bridge is followed 1,400 feet to the north by a left-sided entrance ramp from Tobin Bridge, City Square, and Storrow Drive/Leverett Circle.

Reduced River-Tunnel And Non-River-Tunnel Alternatives: Common to both the Reduced River-Tunnel and Non-River-Tunnel Alternatives north of the Charles River is a left-sided off-ramp to the Tobin Bridge, followed by a merge with a right-sided entrance ramp from New Sudbury Street and a left-sided entrance ramp from Tobin Bridge, City Square, and Storrow Drive/Leverett Circle.

A northbound HOV lane is to the north of the entrance ramp from Storrow Drive/Leverett Circle, for the following reasons:

- It is not possible to provide a dedicated HOV lane within the segment of the I-93 mainline where there will be the concentration of left- and right-sided ramps as described above, because the lane would conflict with movements to or from these ramps.
- A northbound HOV lane could be designed to serve the major traffic movements coming from the ramps entering I-93 to the north of the Charles River, particularly the large volume of vehicles coming from Storrow Drive/Leverett Circle, rather than just the traffic crossing the Charles River on the I-93 mainline.

Continuity with concepts developed by MHD in a separate study for a northbound contraflow lane between the northern Project limits and Route 128 supports beginning the lane to the north of the double-

deck segment of the highway, approximately 1 mile to the north of the Charles River. To the north of the double-deck structure, the northbound and southbound mainline lanes are at the same elevation (side by side), which is required to effect the crossover of vehicles at the entrance and exit points to/from a contraflow lane.

Traffic Conditions. There is little need for a northbound HOV lane within the Project limits, independent of design constraints. Traffic forecasts indicate that northbound lanes within the Project limits will operate without substantial traffic delays. Therefore, a northbound dedicated HOV lane would provide negligible benefits for HOVs, and would not meet standard planning criteria. Speeds in the general-purpose lanes are forecast to be in the range of 45 to 50 mph for the new design alternatives, from the Gilmore Bridge to the Project limits.

Approximately 2.3 miles to the north of the Project limits, however, a capacity constraint is forecast to occur on I-93 at the location of the Route 16 exit ramp. Queuing associated with this capacity constraint is forecast to extend upstream approximately 8,000 feet, substantially to the north of the Project limits.

4.1.6(c) Compatibility With Proposed HOV Facilities To The North Of The Project Limits

In the MHD report cited above, a contraflow lane, to be implemented through the use of moveable concrete barriers, is identified as the most feasible long-range option for providing an HOV lane on I-93 between the Charles River crossing and Route 128. This recommendation was developed in response to a Massachusetts air pollution control regulations (310 CMR 7.37) requiring the evaluation of an extension of the existing I-93 southbound lane northward toward Route 128, and the addition of a northbound HOV lane extending toward Route 128. HOV issues confined to the segment of I-93 within the Project limits were addressed in Sections 4.1.6(a) and 4.1.6(b). This section addresses issues affecting continuity between the design of the Charles River crossing and the proposed contraflow lane, which would be located to the north of the Project limits. These issues concern storage of a vehicle used for placement of moveable barriers, provision of an enforcement area, and transitions between facilities within and beyond the Project limits.

Southbound. The contraflow lane proposed to the north of the Project limits cannot be extended southward to the double-deck section of I-93 at the northern Project limits. The crossover between northbound and southbound lanes required at the contraflow lane entrance and exit cannot be incorporated in a double-deck roadway configuration. The contraflow lane begins and terminates, therefore, on the side-by-side segment of I-93 to the north of the Project limits. The only direct physical connection possible is in the AM peak period from the southbound contraflow lane (the left lane of the northbound direction, beyond the Project limits) to the southbound concurrent flow lane (within the Project limits, in the case of the three new design alternatives). The design of the HOV lane within the Project limits does not present any particular obstacles or constraints to establishing this connection, although the details of this transition need to be developed as part of the continuing design process. In a separate action, MHD has established a process for the coordination of Statewide HOV projects, including those planned for this Project and segments of I-93 to the north of the Project limits.

Northbound. In the northbound direction, physical connections between the Charles River crossing segment of I-93 and the contraflow lane do not represent a substantive concern, because there will not be a northbound HOV lane cannot be accommodated within the Project limits. An issue that could affect the design of the contraflow lane would be the weaving distance required between the general-purpose entrance ramps within the Project limits and the entrance to the contraflow HOV lane. A left-side diverge lane to the HOV entrance must begin at a point that will provide for safe weaving distances from the upstream entrance ramps, which would in effect control the location of the northbound contraflow lane

entrance. The overriding constraint, however, will be the need to begin the contraflow lane where the northbound and southbound mainlines are side by side.

Specification of the northbound HOV entry point would be an element of contraflow design. Scheme Z and the three design alternatives are compatible with a contraflow lane beginning to the north of the Project limits near Sullivan Square.

Storage Of Barrier Transfer Vehicle. Several additional considerations were identified in the MHD's 1992 *High-Occupancy Vehicle Feasibility Study* that concern coordination between the Charles River crossing and the proposed contraflow lane to the north on I-93. The first of these relates to the availability of a storage area within the Charles River crossing for one of two barrier transfer vehicles, which are required to set out the moveable barriers used to separate the contraflow lane from opposing direction general-purpose traffic.

Since the Project is on viaduct north of the Charles River, the siting of a storage area within the mainline or ramp structures is complicated. One possible alternative that warrants further analysis would be a site at grade near the I-93/Rutherford Avenue Service Road and BSG. Several parcels close to the Service Road may be suitable for storage of the barrier transfer vehicle. Access to and from I-93 near the southern entrance/terminus of the contraflow lane is good with the three alternatives, but not with Scheme Z. Unlike the three new design alternatives, Scheme Z does not provide direct ramp access to this area, but requires the barrier transfer vehicle to use a circuitous surface street route through City Square. For this reason, Scheme Z is not compatible with storage of the vehicle in the Service Road/BSG area.

The principal operational difficulty associated with a site in the Service Road/BSG area is the need to drive the barrier transfer vehicle across three I-93 mainline lanes from the left-sided median to the right-sided southbound exit to the parallel viaduct (connecting to Charlestown, Storrow Drive, and Tobin Bridge). Escort vehicles shadowing the barrier transfer vehicle probably are needed to facilitate this movement.

Contraflow Enforcement Area. Another potential compatibility issue concerns the location of an area to monitor and control use of the proposed contraflow lane. A prime location for this enforcement area would be at the entry to the northbound contraflow lane, which would be to the north of the Project limits, where the northbound and southbound I-93 lanes are side by side. Location of the enforcement area on the upper level of the double-deck section of I-93, to the south of the side-by-side section and within the Project limits, would not be practical. Given such limitations, the design of the Charles River crossing does not affect the location of a potential contraflow enforcement area.

4.1.6(d) Bus Access To The Haymarket Area Or Alternative Downtown Terminal

Access to the MBTA Haymarket station or a potential bus terminal on the MBTA Green Line parcel to the south of Causeway Street would be via the exit ramp to Nashua Street, for all four designs. From Nashua Street to the terminal area, buses would travel to Causeway Street (in the case of the Green Line parcel) or Merrimac/New Sudbury Streets (Haymarket) via Lomasney Way. On the reverse trip outbound from downtown Boston, access to I-93 with the three new design alternatives would be via the on-ramp at New Sudbury Street, which is readily accessible from either terminal location. At the present time, the MBTA has not determined a definitive routing strategy for buses entering the downtown area from the north. One possibility under consideration would be to have buses continue beyond the Haymarket area along a Congress Street bus corridor. Access to Congress Street would be from Nashua/Merrimac Streets.

Operating speeds for buses on the viaduct connecting to Nashua Street will be good (generally 27 to 29 mph in the AM and PM peak hours). The distance required to travel via surface streets from the Nashua Street ramp to Haymarket, the Green Line parcel, or Congress Street will be short, and travel time via the outbound route from New Sudbury Street to I-93 would be minimal for the three new design alternatives. The travel time and distance required for access to I-93 north would be substantially greater with Scheme Z, due to the absence of the New Sudbury Street on-ramp. (This Scheme Z impact is described in further detail in Section 4.1.8(a).) Overall, bus connections between I-93 and downtown Boston would require only a few minutes with the new design alternatives, but longer with Scheme Z.

MHD has evaluated a potential direct ramp connection from the southbound Storrow Drive connector to a bus terminal that could be located on the MBTA Green Line parcel south of Causeway Street. This analysis showed that the ramp connection would not be feasible from the standpoint of design, for the following reasons:

- In both Scheme Z and the Non-River-Tunnel Alternative, the Storrow Drive connector bridge would carry two-way traffic. Buses would need to turn left from the connector to the bus ramp, crossing oncoming northbound traffic. This movement would require signalization on the elevated connector at a point of horizontal curvature and a 5 percent downgrade, in violation of design practice.
- There are a number of profile, horizontal space, and structural constraints that in combination would force the ramp into an unacceptable configuration, for all four design alternatives.
- The visual impact of the elevated ramp across Causeway Street may be perceived as negative.

In summary, construction of the bus ramp would be impractical due to physical constraints.

4.1.7 Parking Facilities

The Project boundaries in the Area North of Causeway Street encompass a total of 2,732 parking spaces, on-street and off-street, public and private (see Figure 4.16 and the Transportation Appendix).

The alternatives each generate identical permanent parking losses totalling 687 spaces. This total is 153 spaces more than the 534 spaces that are lost permanently under Scheme Z.

The locations of permanently lost spaces are identified in Table 4.8. This table shows that the three new design alternatives would result in permanent parking displacements of 183 spaces on public property that allow public access; 138 spaces on public property with restricted access; and 366 spaces on private property. For Scheme Z, the respective numbers are 183, 30, and 321.

Mitigation. The MBTA's 1,300-space North Station parking garage under construction will replace all publicly owned spaces lost on a permanent basis as a result of the Charles River crossing with any of the four designs. Owners of the spaces displaced on private property will be compensated for their losses, in accordance with MHD policy for this Project.

4.1.8 Impacts On Public Transportation

The Charles River crossing area is not only a key highway corridor but also contains important elements of the regional public transportation network in a variety of modes: commuter rail, transit bus, light rail, and rail rapid transit. It is also the area in which the proposed North Station/South Station rail link tunnel would have its northern portal and its northernmost station, at North Station. Permanent impacts of the four designs on these public transportation facilities are described in this section (see Chapter 5 for a discussion of temporary construction period impacts).

4.1.8(a) Impacts On Existing And Planned Facilities And Operations

Commuter Rail. None of the four designs has a permanent impact on commuter railroad facilities or operations.

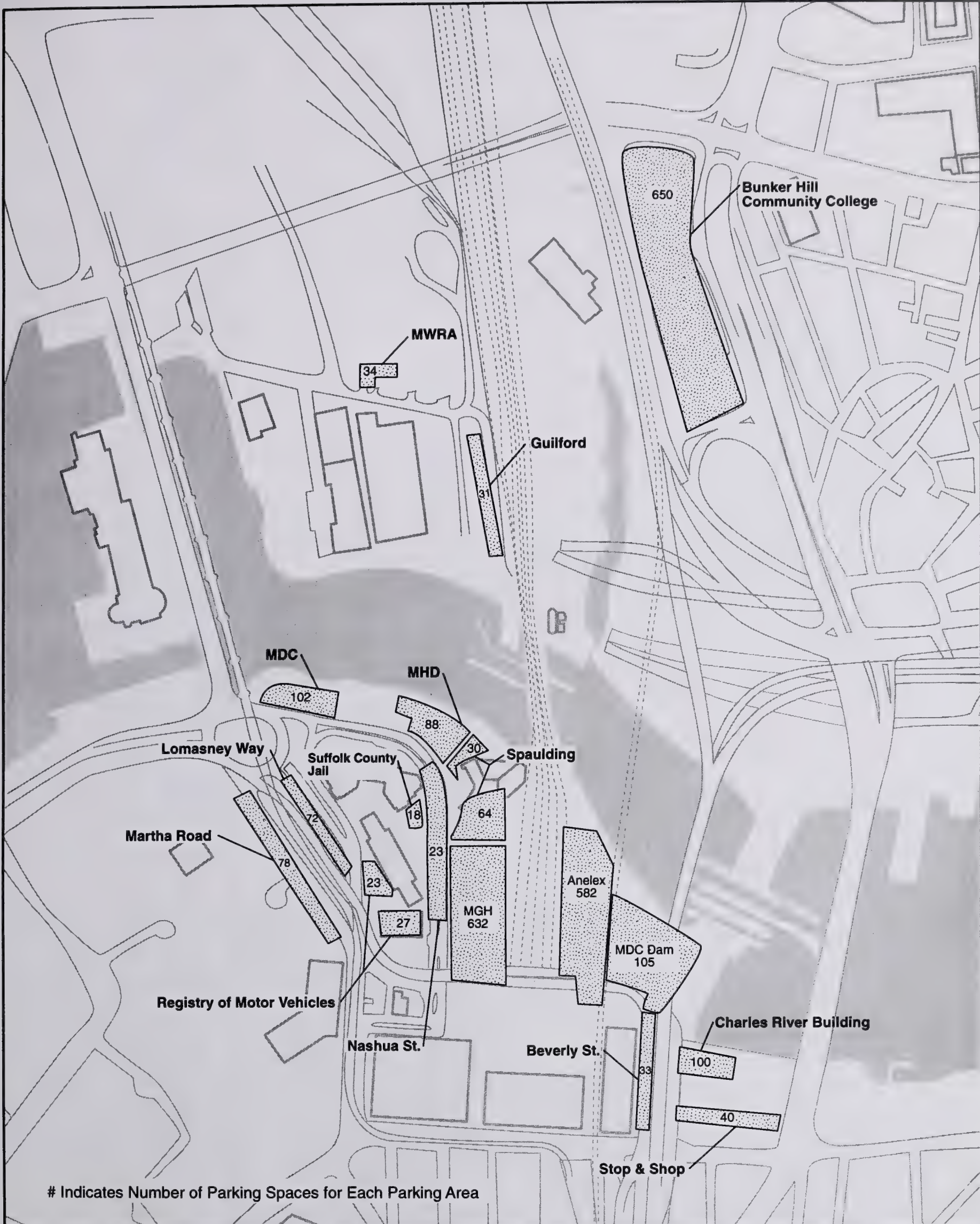
Bus. A total of five MBTA express and local bus routes and several additional bus routes operated by private companies carry passengers to and from Boston via I-93. Four other MBTA bus routes traverse the Project area, via the Charlestown bridge. Two of these routes provide local service to Charlestown via Main and Bunker Hill Streets, respectively, terminating at Sullivan Square. A third local bus route to Woodlawn in Chelsea, and an express bus route originating in Central Square, Lynn, travel over the Tobin Bridge.

Buses travelling to downtown Boston via I-93 are projected to use the Nashua Street exit via the southbound viaduct parallel to the I-93 mainline. The viaduct operates with speeds in the range of 27 to 29 mph (except with 8.1D Mod 5 in the AM peak hour, in which case vehicles would travel at about 20 mph). On the outbound trip from downtown, buses use the I-93 northbound on-ramp at New Sudbury Street, in the case of all three alternatives. The on-ramp connects to the northbound tunnel under the Charles River, with 8.1D Mod 5, and to a viaduct paralleling the I-93 mainline, with the Reduced River-Tunnel and Non-River-Tunnel Alternatives. Speeds on the I-93 viaduct are approximately 30 mph in both the AM and PM peak hours.

With Scheme Z, however, access to I-93 north from the Haymarket area or a potential terminal on the MBTA Green Line parcel to the south of Causeway Street is circuitous. The most likely access points are at Leverett Circle or Assembly Square, to the north of the Project limits, via Rutherford Avenue. Northbound bus access to I-93, therefore, is substantially improved with the alternatives compared to Scheme Z.

Light Rail. The Lechmere Green Line currently is routed through the Project area on a viaduct extending from Lechmere to the North Station transit station via O'Brien Highway, the old Charles River dam, Martha Road, and Causeway Street. A new routing is under construction that will take the line from a portal on Martha Road into a tunnel behind the existing North Station railroad terminal to a new underground "superstation." The superstation will be in the same location as the existing North Station subway station and will serve both the Orange and Green Lines. Planning for the four designs in this area has taken Green Line tunnel and superstation plans into account. As a result, the Project will not interfere with MBTA tunnel construction or Green Line operations.

Rail Rapid Transit. The MBTA's Orange Line rail rapid transit facilities, including two stations (Community College and Sullivan Square), occupy the surface beneath the existing I-93 viaduct from the Charles River to Sullivan Square. The tunnels and viaducts of the Project will be designed to avoid conflicts or disruptions of the Orange Line. The single change anticipated is that the removal of the existing I-93 viaduct for a portion of the distance between the Charles River and Sullivan Square will



FIGURE

4.16

Existing Parking Facilities: Area North Of Causeway Street Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 100 200 300 400 500 FEET

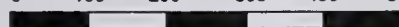


Table 4.8

PERMANENT PARKING DISPLACEMENTS BY PROPOSED ACTIONS

Parcel		Scheme "Z"			8.1D Mod 5			River Tunnel			Non - River Tunnel		
No. Name		Public Access	Private Access	Private Property	Public Access	Private Access	Private Property	Public Access	Private Access	Private Property	Public Access	Private Access	Private Property
1 MDC: Charles River Dam Lot		n/a	30	n/a	0	30	0	0	30	0	0	30	0
2 Anelex (back)		n/a	n/a	290	0	0	335	0	0	335	0	0	335
3 Registry of Motor Vehicles (side)		72	0	0	0	27	0	0	27	0	0	27	0
4 Registry of Motor Vehicles (back)		78	0	0	0	23	0	0	23	0	0	23	0
5 Lomansey Way		0	0	31	72	0	0	72	0	0	72	0	0
6 Martha Road		33	0	0	78	0	0	78	0	0	78	0	0
7 Guilford: B&M Yards		n/a	n/a	n/a	0	0	31	0	0	31	0	0	31
8 Beverly Street		n/a	n/a	n/a	33	0	0	33	0	0	33	0	0
9 Bunker Hill Community College Lot		n/a	n/a	n/a	n/a	58	0	n/a	58	0	n/a	58	0
Total --		183	30	321	183	138	366	183	138	366	183	138	366



weather-expose Community College station platforms, as the protective canopy currently provided by the viaduct will be dismantled.

Boston Helipad. The Chapter 91 license for the Suffolk County Jail and relocation of Nashua Street required removal of the helipad on Nashua Street by December 31, 1994. Any alteration of the projected schedule for removal of the helipad that may be requested by the Federal Aviation Administration is subject to coordination with the MDC and is not a responsibility of the Massachusetts Highway Department or the Central Artery/Tunnel Project.

4.1.8(b) North Station/South Station Rail Link. Concurrent with planning for the Central Artery/Tunnel Project, the EOTC established an independent task force to explore the technical feasibility of connecting the commuter and inter-city passenger (AMTRAK) rail lines north and south of Boston through a tunnel. The tunnel would link two separate railroad operations that currently terminate at North and South Stations, respectively.

The feasibility study prepared by the Central Artery Rail Link Task Force (CARLTF) identified two possible alignments within the Central Artery highway corridor. The two alignments were identical from State Street northward while differing both horizontally and vertically south of State Street. The initial alignment followed a "high" profile under Atlantic Avenue with the southerly portal near Kneeland Street. The task force dismissed this alignment from further consideration due to unresolvable conflicts with the design of the highway Project. The alignment that was recommended by the task force follows a "deep" profile route under the South Station headhouse and the South Station Transportation Center, presently under construction. In this alignment, the rail tunnel would diverge under the existing South Station railroad yard with one branch continuing along the Massachusetts Turnpike right-of-way through Back Bay Station and points west. The second branch would extend southward to service the Old Colony Line currently being rebuilt by the MBTA.

The various tunnel construction techniques recommended in the CARLTF report would allow the rail link to use space within the Central Artery transportation corridor without conflicting with the highway design and construction schedules. There would be several instances where the two projects will directly interface, and the rail link design will take advantage of the highway design and construction techniques available to it. The designs of both projects will be developed such that neither design will preclude the existence of the other.

In the area of the Charles River crossing, as proposed, the rail link would pass along the easterly side of the North Station/new Boston Garden complex now under construction and cross under the Charles River between the existing railroad bascule bridge and the proposed mainline highway bridge. In order to best accommodate each other, the rail link's alignment varies with each of the highway river crossing alternatives included in this DSEIS/R. In all alternatives, the rail link tunnel passes beneath the proposed highway tunnels and viaducts connecting the Central Artery with Route 1 and I-93, eventually surfacing to grade in the existing Somerville railroad yards north of the Gilmore Bridge. Consequently, the rail link can be designed to be compatible with any of the alternatives examined in the DSEIS/R.

4.1.9 Pedestrian And Bicycle Circulation

Planned Improvements. The Project will create the opportunity for extending the Charles River Esplanade/green belt system from the old Charles River dam to Boston Harbor. Plans have been developed by a variety of State and local agencies with jurisdiction in the area that, collectively, would form a comprehensive and coordinated complex of riverside "esplanade" parklands on both sides of the Charles River. The features include continuous bikeways and pedestrian pathways serving both

commuters and recreational users (see Figure 4.17). Proposed lateral connecting pathways into adjacent neighborhoods and to major destinations augment the main riverside paths. Additional features contained in the plans include possible modifications to Freedom Trail and Harborwalk routes.

The present conceptual design of the parklands and pedestrian/bicycle circulation system within and adjacent to the Project area bordering the Charles River is shown in Figure 4.17. Illustrated is a continuous green belt and pathway system on both sides of the Charles. On the north side, the Esplanade extension begins at the old Charles River dam (O'Brien Highway) and extends eastward around North Point to the railroad bridges.

Bicycle and pedestrian pathways moving through the northside green belt would merge for a bridge crossing over the railroad tracks. From that point, the green belt and pathways would continue along the shoreline, and pass under the Charles River bridge crossing to a connection with the Paul Revere Landing Park North adjacent to the new Charles River dam. From this point, pedestrians and cyclists can go under the North Washington Street bridge and connect to a proposed Harborwalk path that accesses the Navy Yard historical site operated by the National Park Service.

On the river's south side, the esplanade green belt would begin at Leverett Circle and the MBTA Science Park station where the existing system ends, and follow the south shore of the river to the railroad bridges and tracks coming out of North Station. As on the north side, a combined bicycle/pedestrian bridge would span over the railroad tracks. The green belt would extend on the far side of the tracks and continue via the grounds of the new Charles River dam and a redeveloped Lovejoy Wharf to the North Washington Street bridge where it would meet the Harborwalk green belt around the Boston Harbor waterfront.

An optional routing for the Freedom Trail has been proposed that has it crossing over the new Charles River dam instead of the North Washington Street bridge and proceed through the Paul Revere Landing Park North before rejoining the existing trail in City Square.

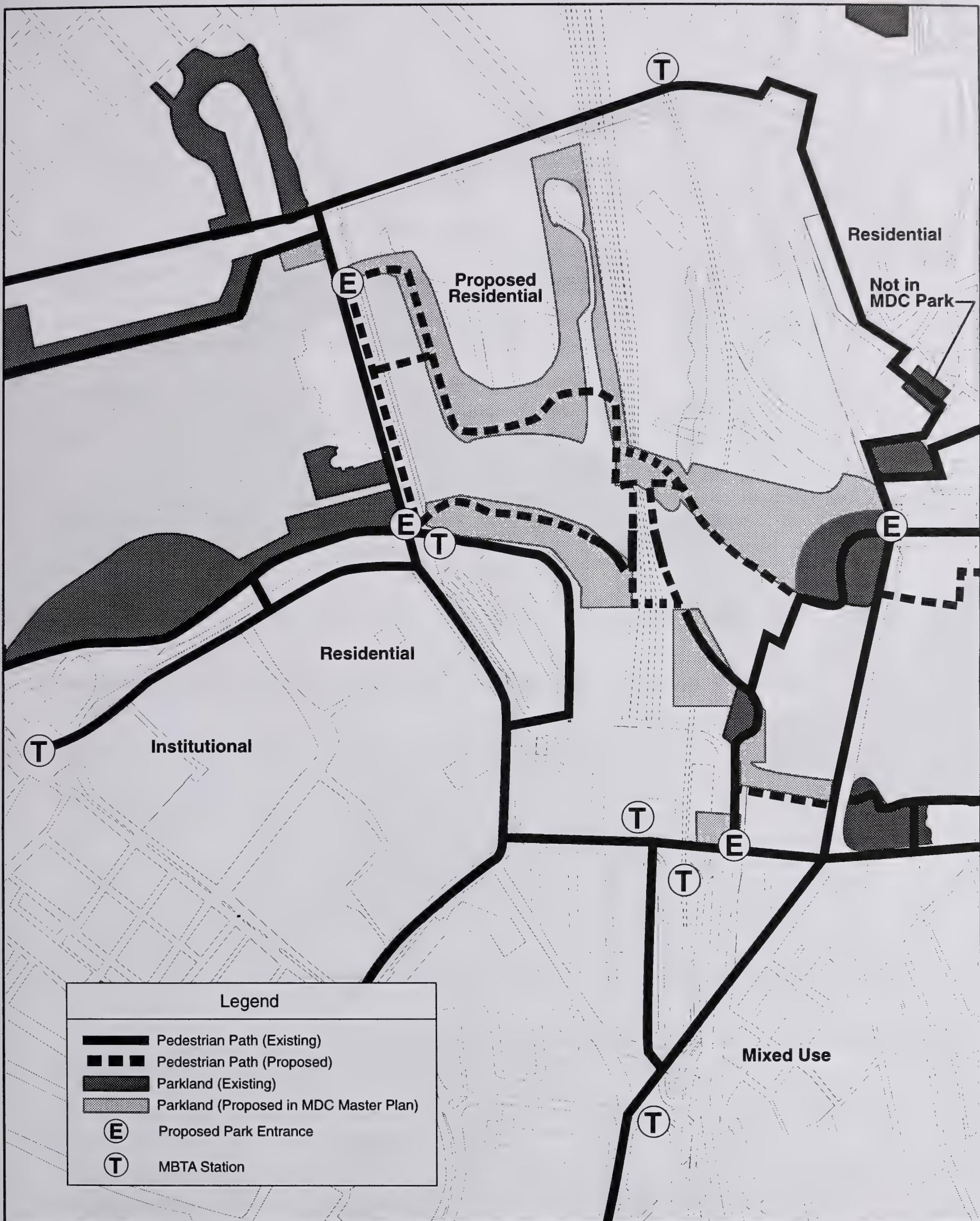
The three new alternatives for the Charles River crossing have varying impacts on the proposed green belt-bikeway/pathway system described above. None precludes any element of the proposed plans from being implemented.

4.2 LAND USE IMPACTS

This section discusses impacts of Scheme Z and the three new design alternatives in the following five subject areas: land use, social conditions and farmlands; open space (except parklands, which are discussed in the Section 4(f) Evaluation at the end of the DSEIS/R); right-of-way and relocations; economics; and joint developments impacts.

4.2.1 Land Use, Social, And Farmland Impacts

None of the Charles River crossing designs (Scheme Z or the three alternatives) has a long-term impact on existing or planned land use patterns. All, however, affect development opportunities of parcels of land on both banks of the river. Joint development impacts are discussed in Section 4.2.5. Social impacts consist primarily of impacts to current and planned open space, as none of the alignments divides existing residential communities. Each of the designs affects existing and planned open space. These impacts are discussed in detail in Section 4.2.2, Parkland Impacts, and in the Section 4(f) Evaluation. There are no farmland impacts; none of the Project area has been in use as farmland for several decades. Regional impacts are the same as those described in the 1991 FSEIS/R, and are not directly related to



FIGURE

4.17

Pedestrian Pathways

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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any Charles River crossing design, but rather to the Central Artery/Tunnel Project as a whole. See Chapter 5.4 for a discussion of temporary, construction period land use impacts. The following discusses long-term land use impacts of each of the four Charles River crossing designs. Tables 4.9 and 4.10 summarize impacts. Figures 4.18 through 4.21 show how the four designs affect the parcels described.

4.2.1(a) 1991 FSEIS/R Proposed Action (Scheme Z)

North Of The Charles River. The many viaducts and loop ramps affect open space along the river's edge (see Section 4.2.2), and the number, height, and location of the loop ramps may negatively affect the development potential of this area. In addition, the loop ramps occupy approximately 1 acre of the proposed North Point development site in East Cambridge. The outer loop ramps are so close to the river's edge that they adversely affect viability of proposed future parkland beneath and next to them.

CANA Ramp T-N, connecting to I-93 northbound, is within approximately 390 feet of the residential community in Charlestown to the east of Rutherford Avenue. BSG has to reconfigure its sand and gravel operations and access because of the viaducts and ramps are located within its property.

The highway infield parcel of land defined by I-93, Rutherford Avenue, the local access road, and CANA Ramp T-N, which has been used by the CANA project for the temporary disposal of contaminated materials will be fenced, capped, and landscaped. This landscaping is a condition of the CANA temporary loop ramps Chapter 91 License. The temporary disposal of materials here was approved by the Massachusetts Department of Environmental Protection.

Scheme Z will have no effect on the BRA-owned parcels west of Rutherford Avenue and north of the access road.

There is no ventilation building on the north bank of the river. Bunker Hill Community College is not affected, as it is with all new alternatives.

South Of The Charles River. Impacts of Scheme Z are primarily on open space, particularly at Paul Revere Landing Park South, because the Charles River bridges shadow most of the park and the design displaces part of it for the bridge abutment. Scheme Z has no long-term impacts on the Massachusetts General Hospital development parcel (currently used for surface parking) along the east side of Nashua Street, as the viaduct connecting I-93 to Storrow Drive is in approximately the same position as the existing viaduct it will replace. Spaulding Rehabilitation Hospital is not affected, although the area around it is changed by future open space and joint development opportunities. Similarly, Scheme Z does not affect the MBTA's air rights garage parcel over the commuter railroad platforms and tracks.

The use of the Massachusetts Registry of Motor Vehicles building at 100 Nashua Street is not affected, except the size of the parcel is reduced on the west side, requiring a minor change in access to the rear of the building.

There are no impacts on the Boston Thermal Energy Corporation's Minot Station Steam Plant, the new Boston Garden development (the Building A parcel), or the Suffolk County Jail.

The widening of Storrow Drive northbound to Leverett Circle results in a narrower landscaped area in that location (approximately a 10,000-square-foot reduction).

Lovejoy Wharf is developed for open space and a water transportation dock as a construction period mitigation measure identified in the 1991 FSEIS/R. In addition, a 75-foot-wide area is available for

vehicular and pedestrian access and landscaping between the west side of the Hoffman Building (its north side faces Lovejoy Wharf) and the I-93 mainline bridge abutment.

There is no ventilation building on the south bank of the river.

4.2.1(b) Alternative 8.1D Mod 5

North Of The Charles River. This alternative reduces the overall mass of the viaduct structure, the supporting piers, and the number of loop ramps. The highway structure is located farther from the residential community east of Rutherford Avenue (approximately 500 feet away; 110 feet farther than with Scheme Z) and proposed developments in the North Point area of Cambridge (approximately 46 feet farther). In addition, the amount of land available for open space along the Charles River is greater than with Scheme Z, increasing benefits for the community.

The I-93 northbound off-ramp to Rutherford Avenue (Ramp C-L) affects recreational uses at Bunker Hill Community College, requiring the reconfiguration of a softball field and jogging track. The construction equipment storage area of a private construction contractor on A Street is also affected. Scheme Z does not affect this property.

BSG has to reconfigure some of its operations to accommodate highway structures, although the number and mass of overhead viaduct structures and columns is reduced from that required for Scheme Z. BSG trucks have greatly improved access (compared to both existing conditions and with Scheme Z) directly between Rutherford Avenue and the regional highway system because of a new at-grade signalized intersection. As a result, concrete trucks headed to and from the north no longer need to use local streets in City Square, thus benefiting the community. Trucks continue to use Rutherford Avenue for a short distance to access I-93 southbound.

Parcel "O", shown in Figure 4.19, located between the I-93 viaduct, Rutherford Avenue, and the new local access road perpendicular to Rutherford Avenue and connecting to Ramps T-N and N-T, is approximately 111,000 square feet larger than that created by Scheme Z. The parcel has frontage on both Rutherford Avenue and the new access road. However, use of the parcel for other than a fenced, landscaped area requires removal or capping of the contaminated soils placed there during the CANA project, with DEP approval. Currently, no active uses of the parcel are planned.

The BRA-owned parcels west of Rutherford Avenue, to the north of the access road, could be expanded in this alternative because Ramp T-N will be further west; this expansion would not be possible with Scheme Z. Ramp S-N will cross the parcels in tunnel and boat section, reducing development opportunities.

There is no ventilation building on the north side of the river.

South Of The Charles River. This alternative has a greater effect on several development parcels than Scheme Z. At the Massachusetts General Hospital development parcel, Ramps C-T, CN-S, L-N, and LC-S restrict potential future building foundation placement (particularly at their confluence in the southwest corner) and occupy subgrade space in the proposed garage. The timing of development on this parcel is also affected by Project construction.

Tunnel Ramps C-T and C-NS under the MBTA commuter railroad parcel requires modification to foundations for the MBTA air rights garage. The I-93/Storrow Drive connector viaduct has no long-term impact on the garage because it will remain in approximately its existing location.

Table 4.9

SUMMARY OF LAND USE IMPACTS NORTH OF THE CHARLES RIVER

Parcels	Scheme Z ¹	Alternatives		
		8.1D Mod 5 ²	Reduced River-Tunnel ³	Non-River-Tunnel ⁴
North Point	Development potential negatively affected by ramps and loss of 1 acre of development site	46 feet away from development area; less highway structure than Scheme Z	44 feet away from proposed buildings; less highway structure than Scheme Z	24 feet away from proposed buildings; less highway structure than Scheme Z; requires changes to planned perimeter road
Boston Sand and Gravel	Operations and access must be reconfigured	Operations must be reconfigured; access improved	Similar to 8.1D Mod 5 with addition of ventilation building on site	Similar to 8.1D Mod 5
CANA infield parcel	No impact (no current access to parcel)	Access to parcel provided; contaminated soils must be removed or capped	Same as 8.1D Mod 5	Same as 8.1D Mod 5
Bunker Hill Community College	No impact	Reconfigured ballfield and jogging track	Same as 8.1D Mod 5	Same as 8.1D Mod 5
BRA-owned parcels	No impact	Parcels can be expanded, but ramp will reduce development opportunities	Same as 8.1D Mod 5, without ramp impacts	Same as Reduced River-Tunnel

Source: Bechtel/Parsons Brinckerhoff

SUMMARY OF LAND USE IMPACTS SOUTH OF THE CHARLES RIVER

Parcels	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
Mass. General Hospital development parcel	No impact	Ramps restrict placement of future building foundations	Similar, although slightly less, than 8.1D Mod 5	Development potential restricted by ramps and relocated Nashua Street
Spaulding Rehab. hospital	No impact	Hospital acquired; site used for ventilation building	Hospital acquired	Hospital acquired
MBTA air rights garage	No impact	Foundation for garage must be modified	Similar to 8.1D Mod 5	Access impeded and size reduced by 49 percent
Registry of Motor Vehicles	Minor change to access at rear of building	Underpinning required; access to rear of building affected	Similar to 8.1D Mod 5	Similar to 8.1D Mod 5
Boston Thermal Plant	No impact	Acquired and demolished	Same as 8.1D Mod 5	Same as 8.1D Mod 5
New Boston Garden development/Building A parcel	No impact	Small additional ground-level development space	Same as 8.1D Mod 5	Similar to 8.1D Mod 5
Suffolk County Jail	No impact	No impact	No impact	No impact
Lovejoy Wharf	Development for water-transportation/open space; 75 foot wide access area	Same as Scheme Z	Developed for water-transportation/open space; 42 foot wide access area	Similar to Reduced River-Tunnel
Storrow Drive sidewalk area	Narrowed landscaped area at Charles River Park apts.	Widened sidewalk area with landscaping	Narrowed sidewalk area with less landscaping	Narrowed sidewalk area with no landscaping
Proposed Project ventilation building(s)	None	none on north bank; One on south bank at Spaulding site	One on north bank at BSG; One on south bank on Mass Gen'l Hospital development parcel	None on north bank; One on south bank on new Nashua Street parcel

Source: Bechtel/Parsons Brinckerhoff



Existing	Proposed	Under Construction
A. Spaulding Rehabilitation Hospital B. Boston Thermal Steam Plant C. Massachusetts Registry Building D. Charles River Park Apartments E. Boston Sand & Gravel F. BRA-owned Parcels G. Bunker Hill Community College H. O'Neill Federal Office Building I. MGH Campus J. Suffolk County Jail	K. Office L. MBTA Air-Rights Garage M. MGH Development Parcel N. North Point Development O. CANA Landscaped Parcel P. Lowell Square Apartments	Q. New Boston Garden (above grade) MBTA Garage (below grade)

FIGURE

4.18

Affected Major Land Use Features: Scheme Z

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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Existing	Proposed	Under Construction
A. Spaulding Rehabilitation Hospital B. Boston Thermal Steam Plant C. Massachusetts Registry Building D. Charles River Park Apartments E. Boston Sand & Gravel F. BRA-owned Parcels G. Bunker Hill Community College H. O'Neill Federal Office Building I. MGH Campus J. Suffolk County Jail	K. Office L. MBTA Air-Rights Garage M. MGH Development Parcel N. North Point Development O. CANA Landscaped Parcel P. Lowell Square Apartments	Q. New Boston Garden (above grade) MBTA Garage (below grade)

FIGURE

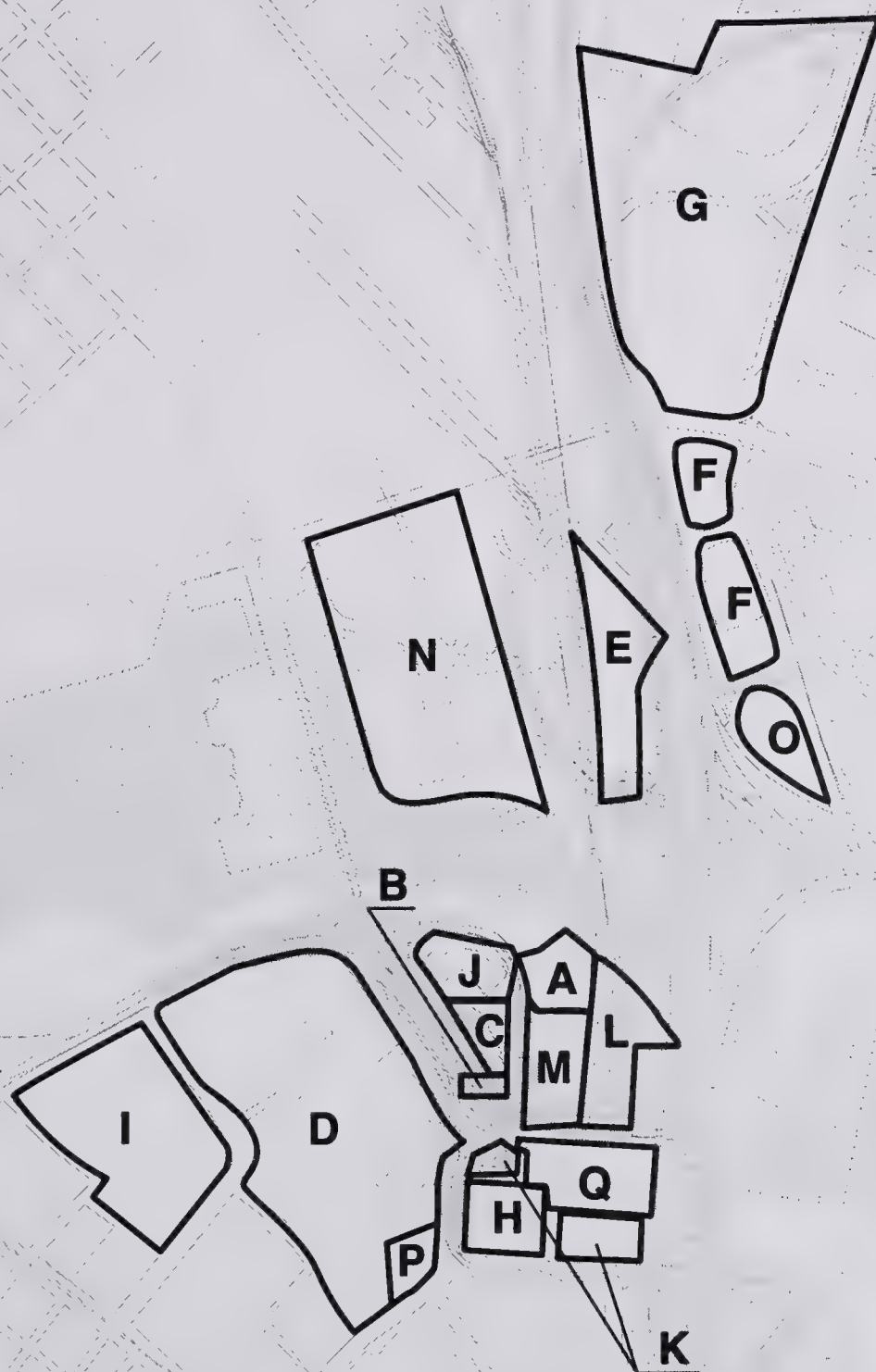
4.19

**Affected Major Land Use Features:
Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





Existing	Proposed	Under Construction
A. Spaulding Rehabilitation Hospital B. Boston Thermal Steam Plant C. Massachusetts Registry Building D. Charles River Park Apartments E. Boston Sand & Gravel F. BRA-owned Parcels G. Bunker Hill Community College H. O'Neill Federal Office Building I. MGH Campus J. Suffolk County Jail	K. Office L. MBTA Air-Rights Garage M. MGH Development Parcel N. North Point Development O. CANA Landscaped Parcel P. Lowell Square Apartments	Q. New Boston Garden (above grade) MBTA Garage (below grade)

FIGURE

4.20

**Affected Major Land Use Features:
Reduced River-Tunnel Alternative**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET





Existing	Proposed	Under Construction
A. Spaulding Rehabilitation Hospital B. Boston Thermal Steam Plant C. Massachusetts Registry Building D. Charles River Park Apartments E. Boston Sand & Gravel F. BRA-owned Parcels G. Bunker Hill Community College H. O'Neill Federal Office Building I. MGH Campus J. Suffolk County Jail	K. Office L. MBTA Air-Rights Garage M. MGH Development Parcel N. North Point Development O. CANA Landscaped Parcel P. Lowell Square Apartments	Q. New Boston Garden (above grade) MBTA Garage (below grade)

FIGURE

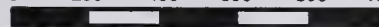
4.21

Affected Major Land Use Features: Non-River-Tunnel Alternative

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

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The realignment of Storrow Drive northbound to Leverett Circle results in a wider landscaped sidewalk area (up to an additional 10 feet).

Acquisition of Spaulding Rehabilitation Hospital is required by this alternative, and a 165-foot by 135-foot above-ground ventilation building is constructed on the site.

The Registry building requires underpinning. Access to the rear egress and loading area of the building is affected by Ramp N-L.

Ramps CN-S and N-S require acquisition and demolition of the Boston Thermal facility. This alternative does not affect the Suffolk County Jail.

Removal of the existing I-93/Storrow Drive viaduct provides some small additional ground-level space at the north end of the new Boston Garden development Tower A parcel.

Lovejoy Wharf is developed for open space and a water transportation dock, as it is in all four designs. In addition, a 75-foot-wide area is available for vehicular and pedestrian access and landscaping between the Hoffman Building and the I-93 mainline bridge abutment.

4.2.1(c) Reduced River-Tunnel Alternative

North Of The Charles River. The impacts of the Reduced-River-Tunnel Alternative are very similar to those described for Alternative 8.1D Mod 5. Highway elements are reduced from those described for Scheme Z, and are approximately 450 feet from the residential community east of Rutherford Avenue (60 feet farther away than in the Proposed Action), and approximately 44 feet from proposed buildings in the North Point development area. This alternative has two loop ramps on the north bank.

BSG has to reconfigure some of its operations, but the mass of piers and overhead structure is less than with Scheme Z, and access improvements are identical to those described for 8.1D Mod 5. A ventilation building, approximately 150 feet by 60 feet by 60 feet high, is located on this portion of the BSG site.

The parcel between the I-93 viaduct, Rutherford Avenue, and the new local access road perpendicular to Rutherford Avenue and connecting to Ramps T-N and N-T is approximately 111,000 square feet larger than that created by Scheme Z. The parcel has frontage on both Rutherford Avenue and the new access road. However, use of the parcel for other than a fenced, landscaped area requires removal or capping of the contaminated soils placed there during the CANA project, with DEP approval. Currently, no active uses of the parcel are planned.

Impacts to the BRA-owned parcels ("F" on Figure 4.20) and the I-93/Rutherford Avenue development parcel are the same as those described for 8.1D Mod 5, although Ramp S-N does not affect the BRA parcels in this alternative.

As with 8.1D Mod 5, the I-93 northbound off-ramp to Rutherford Avenue (Ramp C-L) affects recreational uses at Bunker Hill Community College, requiring the reconfiguration of a softball field and jogging track. The construction equipment storage area of a private construction contractor on A Street is also affected.

South Of The Charles River. At the Massachusetts General Hospital development parcel on Nashua Street, the impacts are almost identical to those described for 8.1D Mod 5, although the impacts are slightly less because of the absence of Ramp C-T. Ramps CN-S, L-N, and LC-S restrict future building foundation placement (particularly at their confluence in the southwest corner) and occupy subgrade

space. A subgrade ventilation building (approximately 120 feet by 60 feet) is on this parcel, further restricting both foundation placement and above-grade building design.

As with 8.1D Mod 5, tunnel Ramps C-T and CN-S under the MBTA commuter railroad parcel require modification to foundations for the air rights garage. The viaduct has no impact on the garage.

The Spaulding Rehabilitation Hospital is affected by this alternative, particularly during construction, as described in Section 5.4. As a result, MHD intends to acquire the site. Following Project construction, the site could be developed for other long-term uses.

The widening of Storrow Drive northbound to Leverett Circle results in a narrower sidewalk area with less landscaping (approximately a 12-foot reduction in width from Scheme Z).

The Registry building requires underpinning. The rear egress and loading area of the building is affected by Ramp N-L. The use of the building is not affected by this design option.

Ramps N-S and CN-S require the acquisition and demolition of the Boston Thermal facility. This alternative does not affect the Suffolk County Jail.

Removal of the existing I-93/Storrow Drive viaduct provides some small additional ground-level space at the north end of the new Boston Garden development Tower A parcel.

Lovejoy Wharf is developed for open space and a water transportation dock. In addition, a 42-foot-wide area is available for vehicular and pedestrian access and landscaping between the Hoffman Building and the I-93 mainline bridge abutment.

4.2.1(d) Non-River-Tunnel Alternative

North Of The Charles River. The impacts of the Non-River-Tunnel Alternative are similar to those described for 8.1D Mod 5. Highway elements are reduced from those described for Scheme Z, and are approximately 450 feet from the residential community east of Rutherford Avenue. The loop ramps are within approximately 24 feet of proposed buildings in the North Point development area and require changes to the planned perimeter road on the east side of the development. There are three loop ramps merging into two loop ramps in this area.

BSG has to reconfigure some of its operations, but the mass of piers and overhead structure is less than with Scheme Z, and improvements to access are identical to those described for 8.1D Mod 5.

The parcel between the I-93 viaduct, Rutherford Avenue, and the new local access road perpendicular to Rutherford Avenue and connecting to Ramps T-N and N-T is approximately 111,000 square feet larger than that created by Scheme Z. The parcel has frontage on both Rutherford Avenue and the new access road. However, use of the parcel for other than a fenced, landscaped area requires removal or capping of the contaminated soils placed there during the CANA project, with DEP approval. Currently, no active uses of the parcel are planned.

Impacts to the BRA-owned parcels and the I-93/Rutherford Avenue development parcel are the same as those described for the Reduced-River-Tunnel Alternative. An electrical substation to service viaduct lighting and other Project needs, approximately 80 feet by 120 feet by 20 feet high, has to be located on the north side of the river. No ventilation building is required on the north side of the river.

As with 8.1D Mod 5, the I-93 northbound off-ramp to Rutherford Avenue (Ramp C-L) affects recreational uses at Bunker Hill Community College, requiring the reconfiguration of a softball field and jogging track. The construction equipment storage area of a private construction contractor on A Street is also affected.

South Of The Charles River. This alternative affects several development parcels. At the Massachusetts General Hospital development parcel, Ramps N-S and S-N are north of the existing viaduct and will slightly reduce the size of the parcel. Tunnel Ramps CN-S and L-CS will be underneath the parcel. Ramp CN-S to the North Station area, in order to surface on the west side of Nashua Street, requires relocating Nashua Street as far east as possible, allowing for a pedestrian connection to the river, and the two new MBTA commuter railroad tracks, and decreases development potential of the Massachusetts General Hospital parcel. However, a new parcel (approximately 72,365 square feet) is created on the west side of relocated Nashua Street, surrounded by Nashua Street, the tunnel, and a ramp/boat section. A 120-foot by 60-foot subgrade ventilation building is constructed on the site. Relocated Nashua Street and Ramp L-CS decreases other development opportunities on the site, although expanded parkland development and a pedestrian connection between North Station and the Charles River are possible (see Section 4.2.5, Joint Development Impacts).

Ramps N-S and S-N traverse the southerly portion of the MBTA commuter railroad parcel air rights garage, removing approximately 49 percent of the garage area, restricting the design of internal circulation. Access to the garage from Nashua Street is impeded somewhat more than in Scheme Z or 8.1D Mod 5. Tunnel Ramps C-T and CN-S under the MBTA commuter railroad parcel require modification to foundations for the air rights garage. The feasibility of developing a garage with these restrictions is discussed in more detail in Section 4.2.5, Joint Development Impacts.

The widening of Storrow Drive northbound to Leverett Circle results in a narrower sidewalk area with no landscaping (approximately a 26-foot reduction in width).

Acquisition of Spaulding Rehabilitation Hospital is required by the relocation of Nashua Street. Following Project construction, the remaining portion of the parcel could be developed for other long-term uses.

The Registry building requires underpinning. The rear egress and loading area of the building is affected by Ramps N-L and N-S. This design does not affect the use of the building.

Ramps N-S and CN-S requires acquisition and demolition of the Boston Thermal facility, leaving a small residual open space at the pedestrian crossing opposite the new Boston Garden Tower A site. Removal of the existing I-93/Storrow Drive viaduct provides some small additional ground-level space at the north end of the new Boston Garden Tower A parcel.

This alternative has no long-term effects on the Suffolk County Jail.

Lovejoy Wharf is developed for open space and a water transportation dock. In addition, a 42-foot-wide area is available for vehicular and pedestrian access and landscaping between the Hoffman Building and the I-93 mainline bridge abutment.

4.2.1(e) Project Ancillary Facilities

In addition to required ventilation building(s) and an electric substation in the Area North of Causeway Street as described above, MHD needs to site other ancillary Project facilities in this area. These facilities are required in Scheme Z and the three alternatives. Although the sites are not selected yet,

these facilities are briefly described below. Consistent with Projectwide procedures, if further environmental documentation is required for the facilities, it will be prepared and filed with regulatory agencies as appropriate. The selection of sites for the facilities is independent of the decision making regarding selection of a preferred alternative for the Charles River crossing. The three MHD facilities to service and support the highway system and its environs are a maintenance facility, an emergency station, and an emergency platform.

- **MHD Maintenance Facility:** This facility requires approximately 1.25 acres. Its purpose is to accommodate personnel and maintenance equipment in the area on a 24-hour basis.
- **MHD Emergency Station:** This facility requires approximately 0.5 acre. Its purpose is to accommodate emergency vehicles and personnel to respond to peak-hour traffic incidents in the area. It will operate on a 24-hour basis and its location will be north of the Charles River to meet critical response times.
- **MHD Emergency Platform:** This facility requires a structure of approximately 250 square feet and two vehicle parking spaces. Its purpose is to accommodate emergency vehicles and personnel to respond to peak hour traffic incidents in the area. It will be located south of the Charles River to meet critical response times.

In addition to these above ancillary Project facilities, MHD has agreed previously to relocate the existing MDC Central Services Facility in the general vicinity north of the Charles River. MHD's agreement does not extend to acquisition of a new site for this facility if it is located outside of this area. This facility requires approximately 3.5 acres. Its purpose is administration, warehousing, and vehicle repair. It will operate on a 24-hour basis, and will be located near the MDC parkland and roadways maintained by the MDC. Any required environmental documentation for this facility will be coordinated with the MDC.

4.2.2 Open Space Impacts

Planning for the Charles River crossing since the inception of the Central Artery/Tunnel Project has focused attention on the open space development potential of the area of the Charles River between the Science Museum and the North Washington Street bridge. Although historically dominated by transportation and industrial uses, this area has in recent years been the subject of extensive planning. The MDC has acquired new parkland parcels in this area, which it plans to develop with the goal of extending the MDC Charles River regional park system from the existing Esplanade to Boston Harbor. MHD actively supports these goals, and has undertaken thorough evaluation of the Charles River crossing designs, resulting in the three new design alternatives which can assist in achievement of these goals.

The Section 4(f) Evaluation in this DSEIS/R provides detailed analysis of the impacts of Scheme Z and the three new design alternatives on designated parkland parcels within this area. In addition, the Section 4(f) analysis specifically describes the status of MDC master planning and the comprehensive proposed parklands mitigation program associated with the four Charles River crossing designs. This section focuses principally on potential impacts to open space and existing or future pedestrian corridors along the river which are not designated 4(f) parklands.

4.2.2(a) Long-Term Impacts North Point.

Affected Environment: The North Point area stretches from its entrance on O'Brien Highway opposite the Science Museum garage south along the inlet of the Charles River and east along the riverbank to the

MBTA railroad crossing. It includes the former GSA parcel which is addressed in the Section 4(f) Evaluation. Mixed use development is planned by the City of Cambridge. The North Point area is a potential independent link in a continuous path system planned by the MDC to connect upstream parkland to the Charlestown Navy Yard waterfront. The North Point area is planned for passive uses enjoying views of the river.

Impacts: Scheme Z results in visual and noise impacts in this area due to its six densely nested loop ramps rising to 105 feet in height and passing within 50 feet of the Charles River. Much of the area next to the railroad tracks would be unusable due to the loop ramps and their piers. There is also a substantial increase in noise, which would adversely affect the use of open space in this area.

Alternative 8.1D Mod 5 has a single loop ramp 35 to 40 feet high, 180 feet from the Charles River. Noise is reduced somewhat by placing three lanes of traffic in a tunnel, avoiding Scheme Z's double river crossings on viaduct. The area next to the railroad tracks is usable as a pedestrian and bicycle pathway, comprising part of the continuous riverfront pathway system from Museum of Science parkland areas, and access to Boston Harbor.

The Reduced River-Tunnel Alternative has a pair of loop ramps 35 to 40 feet high with similar profiles and simple structures 135 feet from the Charles River. Noise is reduced somewhat by placing two lanes of traffic in a tunnel, avoiding Scheme Z's double river crossings on viaduct. The area next to the railroad tracks is usable as a landscaped open space area, although the area shaded by viaduct is wider. A ventilation building located near BSG inside the loop ramp is visible across the railroad tracks from the North Point area.

The Non-River-Tunnel Alternative has three ramps merging to a pair of side-by-side loop ramps 35 to 40 feet high with common profiles and simple structures 135 feet from the Charles River; visual impact is essentially the same as the Reduced River-Tunnel Alternative and similar to that of Alternative 8.1D Mod 5. Noise is reduced somewhat by avoiding the Scheme Z's double river crossings. The area next to the railroad tracks is usable as a landscaped open space area, with an identical shaded area as in the Reduced River-Tunnel Alternative. There is no ventilation building near BSG in this alternative.

In all new alternatives, a pedestrian walking downriver in this area sees a loop ramp or pair of ramps set well back from the river, permitting ample landscaping of the riverbank and separation of pedestrian and bicycle paths. Ramp architecture in the new alternatives is cleaner and simpler than Scheme Z's multilevel nested loop ramps can be because they are removed or realigned with the new alternatives. Views along the riverbank are free of the overhead viaduct structures which extended nearly to the river in Scheme Z, and farther downstream one sees bridges of aesthetically improved design (two bridges with similar profiles in the case of the Non-River-Tunnel Alternative), with fewer bridge piers than in Scheme Z. Views overall are more open and free of columns, which are densely clustered in Scheme Z's loop ramp area. These improvements greatly facilitate the success of the continuous pedestrian connection along this bank of the river from the Esplanade system upstream to Paul Revere Landing Park North and the Boston Harbor waterfront.

Summary: All new alternatives have essentially the same impact on open space in the North Point area and on the recreational use of the river surface. Alternative 8.1D Mod 5 is marginally better than the others; all are a major improvement over Scheme Z. The functional impact of all four designs is the same.

North Bank Transportation Corridor.

Affected Environment: Downstream from the North Point area is a historic transportation corridor which includes the MBTA commuter railroad tracks and bascule bridge, and the existing I-93 bridge. In the past, several more railroad bridges crossed the river in this area. Today, this area is constrained for future parkland development by the CANA City Square tunnel approaches, by the approaches to the pedestrian walkway over the railroad tracks, and by the Millers River outlet through culverts, where the granite seawalls are interrupted and the riverbank cuts inland. The four designs will compress this transportation-constrained area by moving the highway bridge toward the railroad crossing.

The MDC master plan proposes an "Arts Park" in the area next to and under the highway bridge, where environmental artworks, sculpture, and other works of art enhance and attract public use of this area, which is constrained by transportation structures in all alternatives. The master plan also proposes a park-related use such as a cafe in or around the historic railroad signal Tower A, which continues to operate the MBTA bascule drawbridge. While these details of future MDC programming as portrayed in the master plan would be MDC actions separate from the Project, they are suggestive of options which could result in viable future public use of this area as part of the overall regional park system.

Impacts: In Scheme Z, this transportation corridor is covered by ramps extending to the shoreline. A total of 400 lf of shoreline is covered, resulting in shadows that move laterally, affecting different parts of this area depending on the hour and season. Scheme Z has three separate bridges carrying 14 lanes; the one closest to the railroad bridge is double-decked. The northbound mainline bridge tower legs are located on shore and in the river; closer to the railroad bridge, four piers supporting the double-deck Storrow Drive connector bridge are located in the north bank area. These ramps and bridges have an adverse effect on the continuous path system along the north bank of the river, and extensive pedestrian improvements are proposed to address Scheme Z's impacts on this area. The Millers River and the proposed path from Rutherford Avenue are also covered by overhead viaduct.

Alternative 8.1D Mod 5 leaves this area comparatively open, although constrained by surrounding transportation structures, with the closest loop ramp 185 feet from the river's edge, and the single-span, 10-lane mainline bridge 230 feet downstream from the railroad crossing. This bridge is 170 feet wide and covers 220 lf of riverbank, leaving 280 lf of open riverbank next to the railroad crossing. Shadows move laterally, affecting most of this area during the morning. One leg of the bridge's double-pylon tower is on the riverbank, the other near shore in the river. The Millers River is covered in part by overhead viaduct and at-grade roadway; a successful path from Rutherford Avenue at this location continues to be difficult to achieve but the possibility is better than with Scheme Z because of Alternative 8.1D Mod 5's narrower viaduct.

The Reduced River-Tunnel Alternative has a single, 12-lane bridge that is 230 feet wide with both legs of its diamond tower on the riverbank. A stretch of 300 lf of riverbank is in shadow, which moves laterally, affecting this area during morning hours (this shadow is broken in two places by sunlight passing between the main bridge deck and the cantilevered lanes on the upstream and downstream sides). The riverbank between the railroad crossing and highway bridge is bounded by a loop ramp approximately 120 feet from the river. This open area has 280 feet of river frontage. The area is acceptable to pass through as part of the north bank path system. The Millers River and Rutherford Avenue path are covered in part by overhead viaduct and at-grade roadway.

The Non-River-Tunnel Alternative has a 10-lane mainline bridge downstream and a second, four-lane Storrow Drive connector bridge, 70 feet wide, located approximately 100 feet from the railroad bridge. This second bridge limits the open area available for programmed uses near Tower A. The width of this area from the river's edge to the first loop ramp is 120 feet, as in the Reduced River-Tunnel Alternative,

facilitating a more successful design for pedestrians and bicyclists than in Scheme Z. Two segments of the area are covered by bridge shadows, 80 lf of riverbank under the Storrow Drive connector bridge, followed by a 125-foot open area and then 220 lf of shadow under the mainline bridge (this shadow is broken by sunlight passing between the main bridge deck and the cantilevered bridge lanes on the downstream side). Shadows move laterally, affecting different parts of this area, depending on the hour and season. A pair of bridge columns supporting the haunched girder bridge are located in this area along with the same two-legged diamond bridge pier supporting the mainline, as in the Reduced River-Tunnel Alternative. The effects upon the Millers River and Rutherford Avenue north to the river are similar to the other new design alternatives.

In all new alternatives the loop ramps are farther away from the riverbank than in Scheme Z. Accordingly, the experience of a pedestrian walking downriver is substantially different from that in Scheme Z, whose ramps overhang the riverbank or are tangent to it. This additional width, in a formerly highly constrained area, provides room for a superior design of a barrier-free pedestrian overpass at the railroad tracks, and it permits separation of pedestrian and bicycle paths throughout this area. The riverbank is more open and views to both the Charles and Millers Rivers are less obstructed by columns and bridge piers than in Scheme Z. In addition, the new bridge designs are aesthetically superior to Scheme Z's three different bridges. In the Non-River-Tunnel Alternative, which has a second, single-deck bridge in this area, the area between bridges is wider than under Scheme Z and more open, and the entire open space in the transportation corridor is more usable and aesthetically pleasing. As in the North Point area, these improvements reduce the impediment of Scheme Z's constrained riverbank in this area. Accordingly, they greatly facilitate the success of the continuous pedestrian connection along the north bank of the river from the Esplanade system to Paul Revere Landing Park North and the Boston Harbor waterfront, thus achieving a major objective of the MDC's park planning for this area.

Summary: All alternatives move the nearest loop ramp away from the riverbank and thus are a major improvement over Scheme Z in making this an acceptable area to pass through as part of the north bank pedestrian/bicycle path system. Consequently, the successful connection of upstream and downstream park nodes through this portion of riverbank is accomplished in all new alternatives. In addition to this major open space objective, relatively large areas are also made available for open space uses in the transportation corridor, with the largest area available in Alternative 8.1D Mod 5.

South Bank Transportation Corridor.

Affected Environment: This area extends between Paul Revere Landing Park South (which is described and analyzed in the Section 4(f) Evaluation) and the railroad crossing, and includes a concrete riverside walkway built by the MBTA, which is continued downstream from the railroad bridge under Scheme Z and all alternatives. The MDC master plan treats this area primarily as part of the riverfront path system, with a path connection to the new Boston Garden. The master plan also proposes boat landings which may pose a conflict with small boat traffic between the locks of the new dam and the railroad drawbridge. A pedestrian overpass of the North Station platforms is to be provided in connection with a future MBTA air rights development; the master plan proposes a free-standing overpass at a location closer to the river (see Figure 4.22).

Impacts: In Scheme Z, mainline bridges extend into this area, and a double-deck three-lane Storrow Drive connector bridge passes directly over it. Upstream of the Paul Revere Landing Park South, a total of 280 lf of bank is covered by bridge structure (not counting gaps between bridges), whose shadows move laterally, exposing or covering portions of the bank depending on the hour and season. The gap between bridge shadows is 60 lf. Upstream of the double-deck bridge there are 320 lf of open walkway (measured to the moveable span of the railroad bridge where the MBTA walkway now ends). Views are dominated by the underside of Scheme Z's three bridges and their supporting piers. The area receives

hard-surfaced landscape treatment as a Project mitigation measure and provides a vantage point for watching both boats on the river and trains entering and leaving the adjacent North Station.

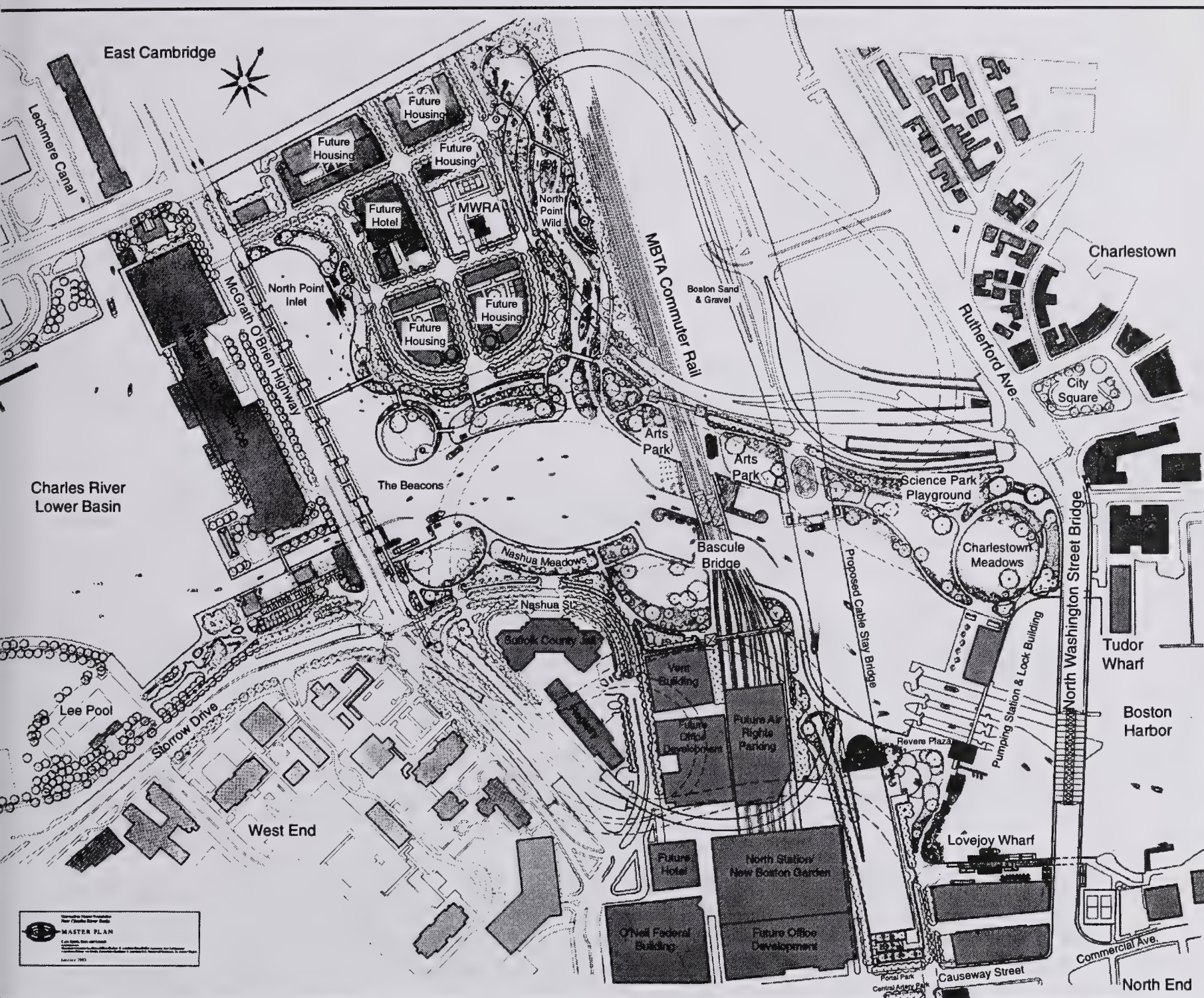
In Alternative 8.1D Mod 5, the cantilevered Storrow Drive connector lanes on the single long-span bridge extend 75 lf beyond the beginning of the granite seawall, where Paul Revere Landing Park South ends. The bridge shadow moves laterally, exposing or covering portions of the riverbank depending on the hour and season. Upstream of the bridge there are 570 lf of open walkway (measured to the moveable span of the railroad bridge where the MBTA walkway now ends). Views are more open than in Scheme Z, although the underside of the aesthetically superior bridge and its needle towers across the river are major elements of the view (see Section 4.9, Visual Impacts). The area is landscaped using hard-surfaced materials and provides a vantage point for watching both boats and trains; it is more open in Alternative 8.1D Mod 5 than in Scheme Z.

In the Reduced River-Tunnel Alternative, the cantilevered Storrow Drive connector lanes on the single long-span bridge extend 100 lf beyond the beginning of the granite seawall, where Paul Revere Landing Park South ends. The bridge shadow moves laterally, covering portions of the bank immediately upstream of the bridge during morning hours; this shadow is broken by sunlight passing between the main bridge deck and the cantilevered lanes on the upstream side. Upstream of the bridge there are 545 lf of open walkway (measured to the moveable span of the railroad bridge where the MBTA walkway now ends). Views are more open than in Scheme Z, although the underside of the aesthetically superior bridge and its diamond piers are major elements of the view (see Section 4.9, Visual Impacts). The area has hard-surfaced landscape treatment and provides a vantage point for watching both boats and trains; it is more open in the Reduced River-Tunnel Alternative than in Scheme Z.

In the Non-River-Tunnel Alternative, the long-span mainline bridge extends 15 feet beyond the beginning of the granite seawall, where Paul Revere Landing Park South ends. A single-deck four-lane Storrow Drive connector bridge passes directly over this area. A total of 175 lf of bank is covered by the single-deck bridge structure, whose shadows move laterally, exposing or covering portions of the bank depending on the hour and season. The gap between bridge structures is 195 lf of riverbank. Upstream of the bridge there are 260 lf of open walkway (measured to the moveable span of the railroad bridge where the MBTA walkway now ends). The underside of the Non-River-Tunnel Alternative's two bridges and their supporting piers are major elements in the views from this area. The area has hard-surfaced landscape treatment and provides a vantage point for watching both boats and trains.

In all new alternatives, this portion of riverbank forms a link in a future continuous pedestrian path system, connecting existing Paul Revere Landing Park South with the future Nashua Street Park and the Esplanade via a future overpass of the railroad tracks (see the Section 4(f) Evaluation for a discussion of these parklands). With the new alternatives the pedestrian passing through this area has a more open view of aesthetically improved bridges compared to Scheme Z, with fewer bridge piers in the view. In the Non-River-Tunnel Alternative, the single-deck bridge permits a simplified system of twin supporting columns, whereas in Scheme Z, the double-deck bridge in this area requires an outside support system of bents holding the bridge decks. While this portion of the south bank is constrained by adjacent land uses in all alternatives, its function as a link between park nodes is successfully achievable in each new alternative.

Summary: Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative have the greatest benefit for open space in this transportation corridor area, leaving it more open than in Scheme Z. The Non-River-Tunnel Alternative also improves this area, providing improved bridge aesthetics and the wider gap between bridges.



Source: Metropolitan District Commission

Note: MDC Plan was prepared based on Alternative 8.1D Mod 5

FIGURE
4.22
1993 MDC Parkland Master Plan For
Lower Charles River Basin
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY (I-93)/TUNNEL (I-90) PROJECT



City Square Park. City Square Park in Charlestown is being constructed by MHD on land made available by the CANA project; it is not addressed in the MDC master plan. In Scheme Z, which lacks a northbound downtown on-ramp but has a local off-ramp at City Square, traffic congestion adversely affects the park setting and access. In all alternatives, northbound traffic can enter the Central Artery at New Sudbury Street, and the local off-ramp is located north of the Gilmore Bridge. Both traffic improvements reduce traffic in City Square and provide a better setting and safer access to the park. Therefore, all alternatives have positive impacts on City Square Park.

Wind Impacts On Pedestrianways. All Charles River crossing alternatives, including Scheme Z, have negligible wind impacts on pedestrianways located at the base of the mainline Charles River bridge tower(s), and no wind impacts at the North Washington Street bridge or the walkway on the Charles River dam locks. These wind effects have been developed from the results of a study of the Erskine Bridge, a cable-stayed structure in Scotland, and wind data at Logan Airport. The basis for the conclusion regarding wind impacts is in Appendix G.

4.2.3 Right-Of-Way And Relocations

This section compares property takings and relocation requirements of Scheme Z and the three new alternatives.

4.2.3(a) Right-Of-Way

Property rights required for Scheme Z and the three new alternatives include full and partial permanent takings. Requirements for construction (temporary construction easements) will be identified during design development. All three new design alternatives require more permanent takings than Scheme Z, and have greater right-of-way impacts than Scheme Z on both sides of the Charles River.

On the south side of the Charles River, all new design alternatives require the taking of Spaulding Rehabilitation Hospital, and the Boston Thermal Energy Corporation's Minot Station steam generating plant. On the north side of the Charles River, all three new alternatives require the reconfiguration of Bunker Hill Community College playing fields and jogging track.

The increase in the total number of parcels affected and the total area taken for all new alternatives is due to differences in their alignments, and their tunnel, structure, and at-grade elements. Comparisons are shown in Table 4.11.

The affected land parcels in the Charles River crossing area are identified on Figure 4.23. Tables 4.12 through 4.14 show current parcel ownerships and uses, and indicate the extent of acquisition required for each of the alternatives. If there is no taking of a property, the space on the tables is left blank to show comparisons. Detailed right-of-way information for Scheme Z is included in the 1991 FSEIS/R and is not repeated here.

The properties that are affected by Scheme Z and the three alternatives and the extent of acquisition required are based on conceptual designs as developed to date. More precise information will become available as preliminary and final design refinements are made on the preferred alternative, and as the appraisal/acquisition process is completed. Additional right-of-way for each of the alternatives may be required.

Following is a discussion of right-of-way impacts by design.

Scheme Z: Scheme Z requires three permanent full takings. In addition, Scheme Z requires the acquisition of 24 permanent partial takings. The total area of all permanent takings is 777,581 square feet (sf). Scheme Z does not affect the Spaulding Rehabilitation Hospital or Bunker Hill Community College.

Alternative 8.1D Mod 5: Alternative 8.1D Mod 5 requires four permanent full takings, one more than Scheme Z. The full takings are of the Minot Station and MDC lands near Leverett Circle. In addition, this alternative requires the acquisition of 28 permanent partial takings. An underground easement is required under parcel 46, currently State-owned and used as a helipad and parking lot, for construction of the ventilation duct. The total area of all permanent takings is 829,851 sf, which is 52,270 sf more than Scheme Z.

Additional properties partially affected by the alternative that are not affected by Scheme Z include Bunker Hill Community College, Spaulding Rehabilitation Hospital, Leed Realty Trust, North Shore Realty Trust, and a State-owned parcel (the site of the future MDC Nashua Street Park). Since part of the Spaulding Hospital property is required for the right-of-way, the building will be taken.

Reduced River-Tunnel Alternative: The Reduced River-Tunnel Alternative requires six permanent full takings, three more than Scheme Z. The full takings are of the Minot Station, MDC lands near Leverett Circle, and an MDC pedestrian access along the east side of Storrow Drive, north of Blossom Street alongside the Charles River Park apartments. In addition, the alternative requires the acquisition of 27 permanent partial takings. The total area of all permanent takings is 1,081,811 sf, which is 304, 230 sf more than Scheme Z.

Additional properties partially affected by the Reduced River-Tunnel Alternative that are not affected by Scheme Z include Bunker Hill Community College, Spaulding Rehabilitation Hospital, a commercial property owned by Gerald D. Conway et al., a commercial property owned by the Boston Redevelopment Authority, and a State-owned parcel (the site of the future Nashua Street Park).

Non-River-Tunnel Alternative: The Non-River-Tunnel Alternative requires five permanent full takings, two more than Scheme Z. The full takings are of the Minot Station and MDC lands near Leverett Circle.

In addition, the Non-River-Tunnel Alternative requires the acquisition of 26 permanent partial takings. The total area of all permanent takings is 1,244,021 sf, which is 466,440 sf more than Scheme Z.

Additional properties partially affected by the Non-River-Tunnel Alternative that are not affected by Scheme Z include Bunker Hill Community College, Spaulding Rehabilitation Hospital, a commercial property owned by Gerald D. Conway et al., lands owned by the Boston Redevelopment Authority, and a State-owned parcel (the site of the future Nashua Street Park). There are also greater impacts to the MBTA railroad track area.

4.2.3(b) Relocation Impacts

The three alternatives displace additional major commercial properties in comparison to Scheme Z. All relocations are carried out in accordance with Public Law 91-646, following Project procedures. These relocation procedures are discussed in the 1991 FSEIS/R and are not repeated here. Scheme Z and the three new alternatives do not result in any residential displacements.

Scheme Z: Scheme Z requires the reconfiguration of BSG's operations and access, and reduces the size of the Massachusetts Registry of Motor Vehicles parcel at 100 Nashua Street. Scheme Z does not affect

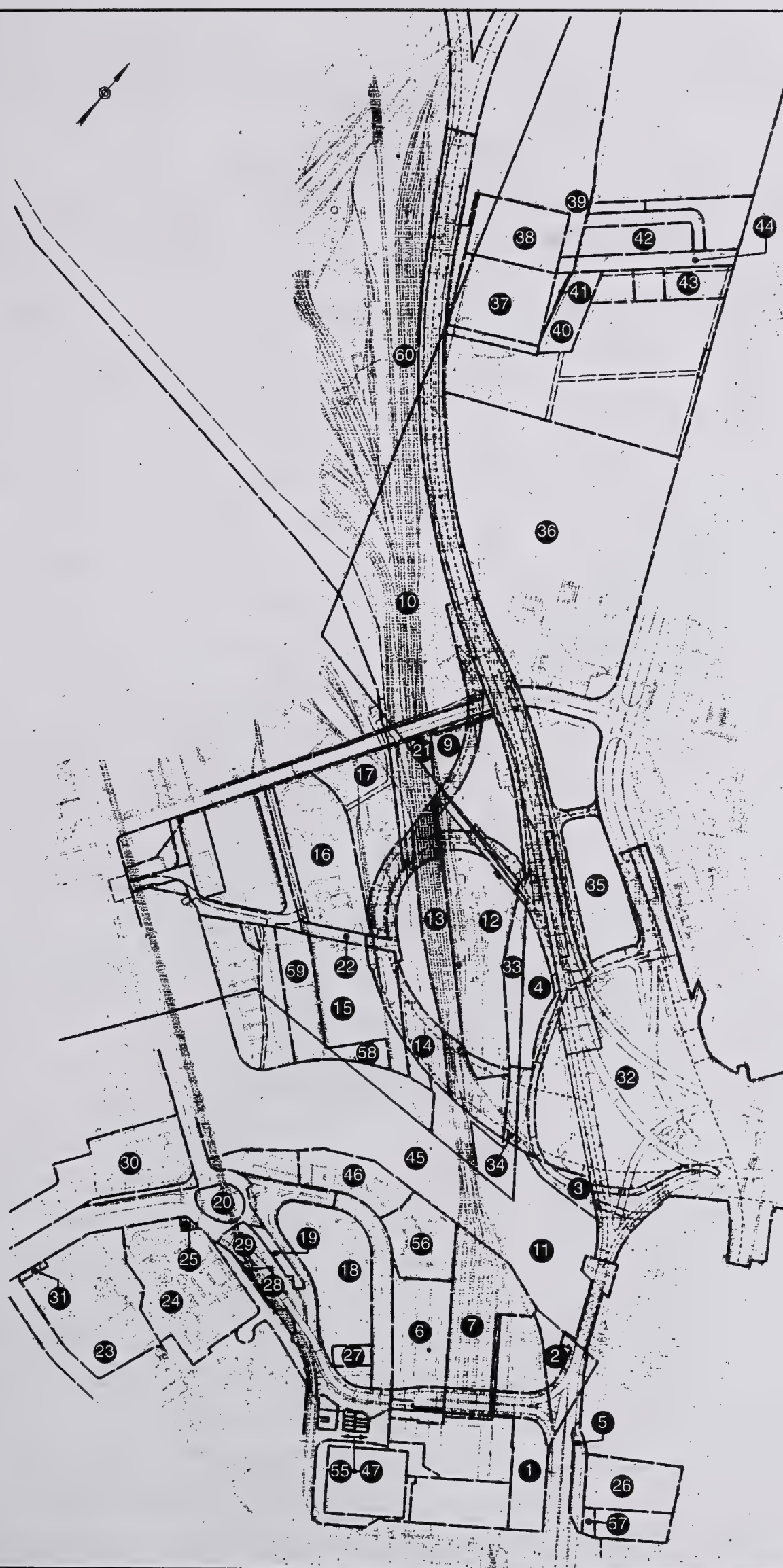
Table 4.11**Comparison Of Property Takings By Design**

	Scheme Z	Alternatives		
		8.1D Mod 5 ¹	Reduced-River-Tunnel ¹	Non-River-Tunnel ¹
Number of permanent partial takings	24 parcels	28 parcels	27 parcels	26 parcels
Number of permanent full takings	3 parcels	4 parcels	6 parcels	5 parcels
Total parcels affected by permanent takings	27 parcels	32 parcels	33 parcels	31 parcels
Total area of permanent takings	777,581 sf	829,851 sf	1,081,811 sf	1,244,021 sf

¹

These takings do not include the easements for the CANA connections acquired in 1986, nor the fee takings necessary for the surface street intersection to be located northerly of the O'Neill Federal Building. A fee taking is acquisition of all ownership rights to the parcel.

Source: Bechtel/Parsons Brinckerhoff



FIGURE

4.23

Right-Of-Way Parcels

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



Table 4.12

**Right-of-Way/Land Ownership
Alternative 8.1D Mod 5**

Permanent Takings (approx. sf)						
Parcel No.	Property Owner	Current Use	P/F**	Fee Taking	Underground Highway Easement	Overhead Highway Easement
1	MHD*	office/parking	P			
2	MDC*	parking	P			22,300
3	MHD*	roadway/highway	F			
4	Millers River*	roadway/highway	F	62,080		
5	MHD	Beverly Street parking	P			
6	Mass. General Hospital .	parking	P	36,300		
7	MBTA*	tracks/platforms	P	36,300		
9	Boston Sand & Gravel	sand/gravel operations	P	89,600		12,400
10	MBTA*	railroad track area	P	37,400		74,800
11	MDC*	Charles/Millers Rivers				
12	Boston Sand & Gravel	sand/gravel operations	P			35,200
13	MBTA*	railroad track area	P			9,400
14	MHD*	highway (proposed)				
15	Boston & Maine Corporation	warehouse	P			10,100
16	MDC*	sewer plumbing/chl sta	P			18,600
17	Boston & Maine Corporation	light industrial	P			35,300
18	DCPO*	office/institutional	P	33,800	18,750	
19	MDC*	roadway	F	15,251		
20	MDC*	Leverett Circle (MBTA station above)	F	27,900		
21	MBTA*	railroad track area	P			300
22	MBTA*	access road	P			200
23	Charles River Park "A" Co.	landscaped area	P	10,300		
24	Whittier Pl. Condo Trust	landscaped area	P	7,100		
25	MDC*	pedestrian access	P	2,300		
26	Chardon Realty Trust ¹	parking/wharf	P			
27	Boston Thermal Energy Corp.	steam plant	F	15,270		
28	MHD*	highway/maintenance				
29	MHD*	highway/maintenance				
30	MDC*	police station/parking	P	16,700		
31	MDC*	pedestrian access	P	2,700		

¹ Extent of acquisition uncertain at this time.

Table 4.12 (cont.)

**Right-Of-Way/Land Ownership
Alternative 8.1D Mod 5**

Parcel No.	Property Owner	Current Use	P/F	Fee Taking	Underground Highway Easement	Overhead Highway Easement
32	MHD*	highway				
33	Millers River*	roadway/highway	P			40,200
34	MHD*	highway (proposed)				
35	BRA	parking	P	10,100	10,900	
36	Bunker Hill Comm'ty College*	college	P	24,100		69,900
39	Boston & Maine Corporation	street	P			
40	Gerald D. Conway, et al	commercial	P			
43	BRA	commercial	P			
44	owner unknown	street	P			
45	MDC*	Charles River				
46	DCPO*	parking/heliport	P		10,250***	
56	The Spaulding Rehab. Hospital Corp	rehabilitation hospital	P	13,250		
58	Leed Realty Trust	commercial	P	17,100		
59	North Shore Realty Trust	commercial	P	3,700		
60	MBTA*		P			

* Commonwealth of Massachusetts

** P = Partial; F = Full

*** underground easement for ventilation system duct not included

Source: Bechtel/Parsons Brinckerhoff

Table 4.13

**Right-of-Way/Land Ownership
Reduced-River-Tunnel Alternative**

Permanent Takings (approx. sf)						
Parcel No.	Property Owner	Current Use	P/F**	Fee Taking	Underground Highway Easement	Overhead Highway Easement
1	MHD*	office/parking				
2	MDC*	parking	P			25,200
3	MHD*	roadway/highway				
4	Millers River*	roadway/highway	F	62,080		
5	MHD	Beverly Street parking				
6	Mass. General Hospital	parking	P	11,200	32,120	
7	MBTA*	tracks/platforms	P		37,130	5,080
9	Boston Sand & Gravel	sand/gravel operations	P	93,600		12,180
10	MBTA*	railroad track area	P	42,150		72,150
11	MDC*	Charles/Millers Rivers	P			140,980
12	Boston Sand & Gravel	sand/gravel operations	P	11,290	11,160	33,950
13	MBTA*	railroad track area	P		950	25,330
14	MHD*	highway (proposed)				
15	Boston & Maine Corporation	warehouse	P		1,290	300
16	MDC*	sewer plumbing/chl sta	P			10,160
17	Boston & Maine Corporation	light industrial	P			42,840
18	DCPO*	office/institutional	P	33,730	14,860	
19	MDC*	roadway	F	15,251		
20	MDC*	Leverett Circle (MBTA station above)	F	27,900		
21	MBTA*	railroad track area	P			690
22	MBTA*	access road	P			850
23	Charles River Park "A" Co.	landscaped area	P	10,820		
24	Whittier Pl. Condo Trust	landscaped area	P	8,890		
25	MDC*	pedestrian access	P	2,660		
26	Chardon Realty Trust ¹	parking/wharf	P			
27	Boston Thermal Energy Corp.	steam plant	F	15,270		
28	MHD*	highway/maintenance				
29	MHD*	highway/maintenance				
30	MDC*	police station/parking	P	18,830		
31	MDC*	pedestrian access	F	4,010		

¹ Extent of acquisition uncertain at this time.

Table 4.13 (cont.)

Right-Of-Way/Land Ownership
Reduced-River-Tunnel Alternative

Parcel No.	Property Owner	Current Use	P/F	Fee Taking	Underground Highway Easement	Overhead Highway Easement
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32	MHD*	highway				
33	Millers River*	roadway/highway	F	2,110	3,650	42,180
34	MHD*	highway (proposed)				
35	BRA	parking	P	9,820		
36	Bunker Hill Comm'ty College*	college	P	29,560		65,790
39	Boston & Maine Corporation	street				
40	Gerald D. Conway, et al	commercial	P			6,210
43	BRA	commercial	P	1,960		
45	MDC*	Charles River	P		49,460	
46	DCPO*	parking/heliport	P		11,590	
56	The Spaulding Rehab. Hospital Corp.	rehabilitation hospital	P		1,350	
58	Leed Realty Trust	commercial				
59	North Shore Realty Trust	commercial				
60	MBTA*	railroad tracks	P			33,230

** P = Partial; F = Full

Source: Bechtel/Parsons Brinckerhoff

Table 4.14

**Right-of-Way/Land Ownership
Non-River-Tunnel Alternative**

Permanent Takings (approx. sf)						
Parcel No.	Property Owner	Current Use	P/F**	Fee Taking	Underground Highway Easement	Overhead Highway Easement
1	MHD*	office/parking				
2	MDC*	parking	P	7,310		17,890
3	MHD*	roadway/highway				
4	Millers River*	roadway/highway	F	62,080		
5	MHD	Beverly Street parking				
6	The Mass. General Hospital	parking	P	43,810	34,280	
7	MBTA*	tracks/platforms	P		35,220	39,390
9	Boston Sand & Gravel	sand/gravel operations	P	102,450		9,350
10	MBTA*	railroad track area	P	40,460		73,990
11	MDC*	Charles/Millers Rivers	P			177,010
12	Boston Sand & Gravel	sand/gravel operations	P			64,070
13	MBTA*	railroad track area	P			34,540
14	MHD*	highway (proposed)				
15	Boston & Maine Corporation	warehouse	P			1,950
16	MDC*	sewer plumbing/chl sta	P			20,340
17	Boston & Maine Corporation	light industrial	P			58,430
18	DCPO*	office/institutional	P	59,740	10,990	
19	MDC*	roadway	F	15,251		
20	MDC*	Leverett Circle (MBTA station above)	F	27,900		
21	MBTA*	railroad track area	P			2,510
22	MBTA*	access road	P			1,850
23	Charles River Park "A" Co.	landscaped area	P	9,800		
24	Whittier Pl. Condo Trust	landscaped area	P	8,840		
25	MDC*	pedestrian access	P	2,660		
26	Chardon Realty Trust ¹	parking/wharf				
27	Boston Thermal Energy Corp.	steam plant	F	15,270		
28	MHD*	highway/maintenance				
29	MHD*	highway/maintenance				
30	MDC*	police station/parking	P	18,850		
31	MDC*	pedestrian access	P	3,010		

¹ Extent of acquisition uncertain at this time.

Table 4.14 (cont.)

**Right-Of-Way/Land Ownership
Non-River-Tunnel Alternative**

Parcel No.	Property Owner	Current Use	P/F	Fee Taking	Underground Highway Easement	Overhead Highway Easement
32	MHD*	highway				
33	Millers River*	roadway/highway	F	4,680		43,270
34	MHD*	highway (proposed)				
35	BRA	parking	P	9,700		
36	Bunker Hill Comm'ty College*	college	P	29,560		65,790
39	Boston & Maine Corporation	street				
40	Gerald D. Conway, et al	commercial	P			6,210
43	BRA	commercial	P	1,960		
45	MDC*	Charles River				
46	DCPO*	parking/heliport	P	11,010		
56	The Spaulding Rehab. Hospital Corp.	rehabilitation hospital	P	39,370		
58	Leed Realty Trust	commercial				
59	North Shore Realty Trust	commercial				
60	MBTA*	railroad tracks	P			33,230

* Commonwealth of Massachusetts
 ** P = Partial; F = Full
 Source: Bechtel/Parsons Brinckerhoff

either the Spaulding Rehabilitation Hospital, or the Boston Thermal Energy Corporation's Minot Station steam generating plant adjacent to 100 Nashua Street.

Alternative 8.1D Mod 5: Alternative 8.1D Mod 5 requires the taking of the Spaulding Rehabilitation Hospital on Nashua Street, the Boston Thermal Energy Corporation's Minot Station, and a portion of a warehouse structure on Industrial Park Drive (North Shore Realty Trust) north of Bunker Hill Community College. Early acquisition of the Spaulding Rehabilitation Hospital is required to expedite the replacement of the existing facility and provide for an orderly relocation of the hospital. Discussions with Boston Thermal regarding relocation options are underway and not yet concluded.

Reduced River-Tunnel Alternative: The Reduced River-Tunnel Alternative requires the taking of the Spaulding Hospital and Boston Thermal's Minot Station. Again, with this alternative, an early acquisition of the hospital is necessary to facilitate an orderly relocation.

Non-River-Tunnel Alternative: The Non-River-Tunnel Alternative requires the taking of the Spaulding Hospital and Boston Thermal's Minot Station. An early acquisition of the hospital is necessary to facilitate an early and orderly relocation.

4.2.4 Economic Impacts

The long-range economic impact forecasts for the design year 2010 presented in the 1991 FSEIS/R remain valid. The nature of economic activity is such that there will be continued fluctuations in the regional business cycle during the coming 2 decades. These macro-economic fluctuations will have far greater impacts on the economy of the study area than will any of the design changes described herein. Therefore, it is anticipated that the overall economic impacts on the study area and the region will be the same under these design changes as under the FSEIS/R Proposed Action.

Nevertheless, the alternatives to Scheme Z will have positive aesthetic impacts on the proposed North Point development in East Cambridge on the north bank of the Charles River and on Charlestown. This will occur because the alternatives will reduce the number of loop ramps in comparison to Scheme Z. The improvement in aesthetics resulting from the reduction in number of loop ramps will have an effect on economic activity in these areas. The improvements will make both areas more attractive for development and for locating commercial, residential, or other development activity, and therefore potentially improve the viability of the sites once they are developed.

4.2.5 Joint Development Impacts

Joint development can occur where the Project alignment is over, under, or adjacent to land that has the potential to be developed for purposes unrelated to the Project. The purpose of this section is to identify joint development impacts for each of the alternatives. The section is written as though the joint development potentials have been realized, as appropriate, to match the description of the alternatives.

Parcel Description. Four parcels of land have potentials for joint development. On the south bank of the Charles River, in or adjacent to the BRA's North Station Economic Development Area (EDA) are: the Massachusetts General Hospital (MGH) Nashua Street Parcel, the MBTA Air Rights Garage Parcel, and the Lomasney Way Parcel. On the north bank is the Rutherford Avenue parcel. The locations of the parcels are shown on Figure 4.24.

- **MGH Nashua Street Parcel:** This parcel is located between the MBTA commuter railroad tracks and Nashua Street, north of the new Boston Garden development site. Under the City of

Boston's North Station EDA subdistrict regulations, development of this parcel is permitted to a height of 250 to 300 feet, with a floor area ratio (FAR) of 8 to 10. The land area is defined on the west by Nashua Street, which carries two lanes of traffic in each direction; the MBTA railroad tracks on the east; the riverside park on the north; and elevated ramps and high-rise buildings on the south, including the future high-rise buildings of the new Boston Garden development commercial complex. The land is owned by MGH.

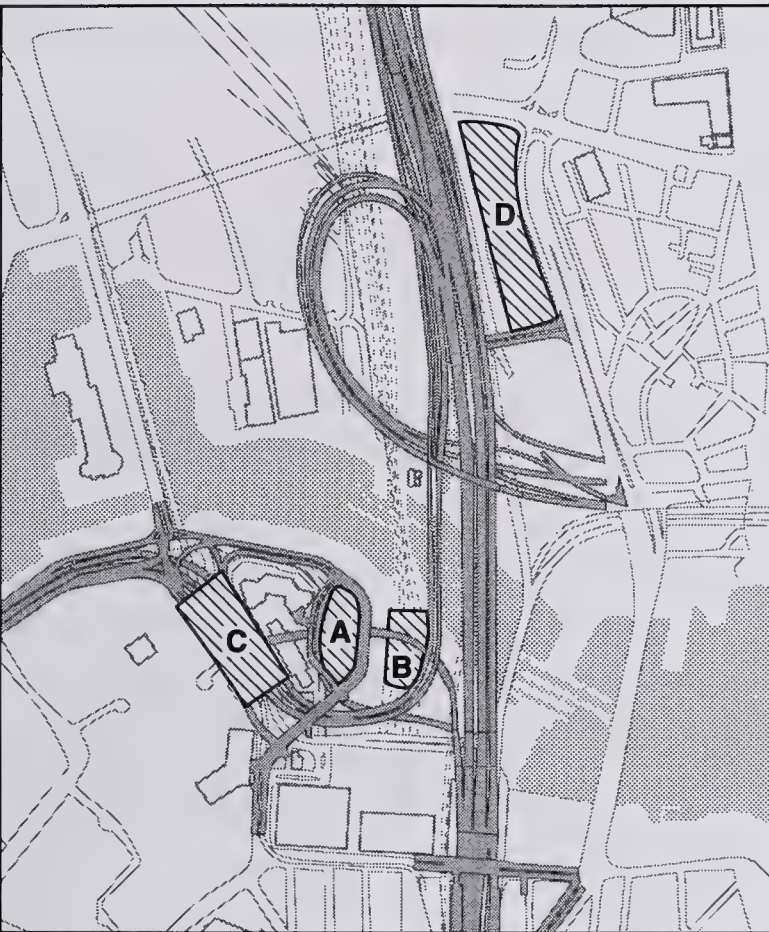
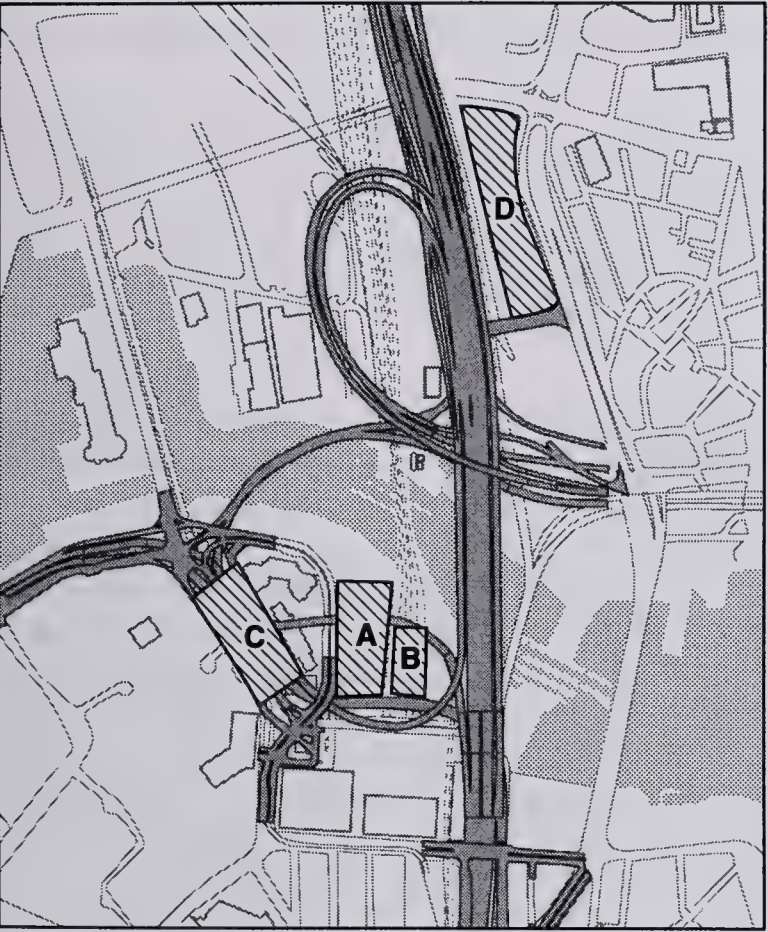
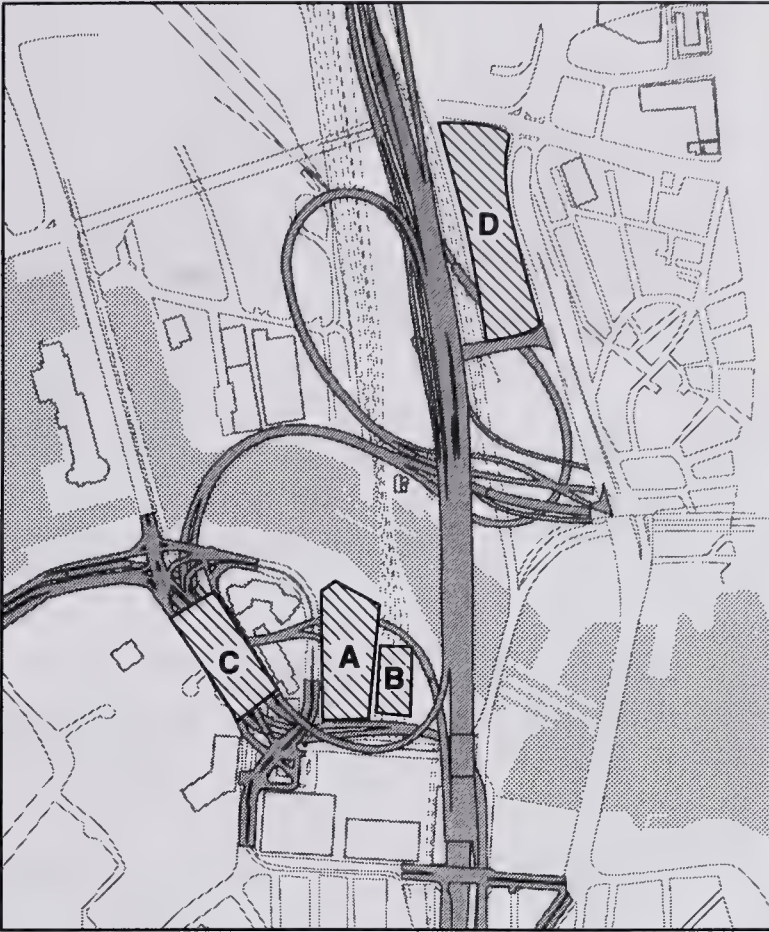
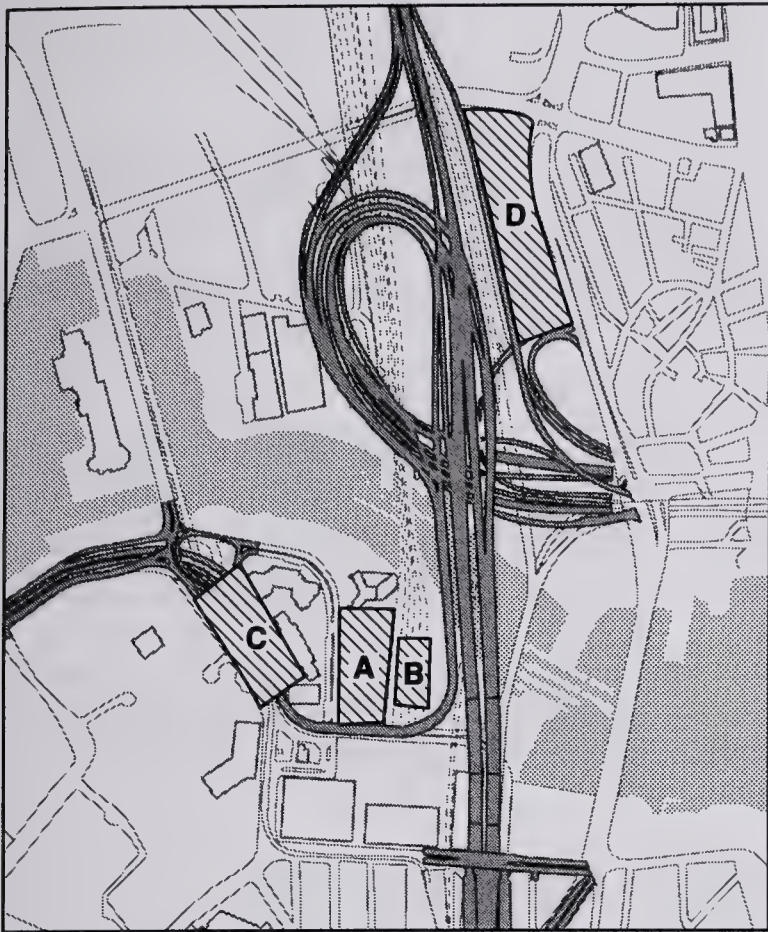
- **Air Rights Garage Parcel:** This parcel is located above the MBTA railroad tracks, between Tracks 1 and 10, and north of the new Boston Garden. The air rights garage is also a part of the North Station EDA subdistrict. It is zoned for development as parking or transportation access. It does not include air rights above the proposed Tracks 11 and 12.
- **Lomasney Way Parcel:** This parcel is adjacent to the North Station EDA subdistrict. It is located in a corridor 210 feet wide between Martha Road and Lomasney Way, between the Registry building and the Charles River Park apartment complex. For the housing community this area is a "front yard"; for the Registry building a "back yard," where loading and service docks presently exist. Martha Road provides access to Charles River Park, and Lomasney Way access to the Registry building. Both streets carry traffic between Causeway Street and Leverett Circle.
- **Rutherford Avenue Parcel:** This parcel is located between Rutherford Avenue and the service road to BSG. The land is zoned for general industrial uses. Its joint development potential is affected only by Alternative 8.1D Mod 5. It is not affected by Scheme Z or the other two alternatives. The parcel is owned by the BRA.

Methodology. Joint development impacts on the three parcel areas south of the Charles River are discussed by comparing the three new alternatives to Scheme Z. For each parcel the first consideration is to determine whether any feasible development potential exists and to identify the nature of that development, including impacts on the site planning and configuration of each parcel, and the buildable area according to current zoning regulations. The second consideration is the impact of Project alternatives on existing or possible pedestrian connections to the joint development parcels. Third, the impact of highway options on the neighboring context, exposure, and amenity of each joint development parcel is discussed.

In addition, the influence of three major surrounding developments proposed to be built by others before 2000 has been assumed: (1) The relocation of the MBTA elevated Green Line to a subgrade alignment through the Lomasney Way parcel, including the reconstruction of Science Park station, (2) the additional MBTA railroad Tracks 11 and 12, west of the existing Track 10, extending in the future to meet the north facade of the existing Boston Garden, and (3) the completion of the new Boston Garden development, including Buildings A, B, and C at approximately 400 feet high, on Nashua Street and Causeway Street.

4.2.5(a) Scheme Z

Scheme Z locates Ramps CN-S and S-CS (the Storrow connector viaduct) in two tiers, on viaduct between the North Station and the Nashua Street joint development parcel. The Lomasney Way parcel is partially occupied by ramps of the Storrow connector viaduct. This design allows development above and below ground on the Nashua Street parcel between Spaulding Hospital and Building A of the new Boston Garden. The air rights garage parcel could be developed to its full potential. The Lomasney Way parcel has no feasible development opportunities.



Reduced River-Tunnel Alternative

Non-River-Tunnel Alternative

Legend	
A.	Nashua Street Parcel
B.	Air-Rights Garage Parcel
C.	Lomasney Way Parcel
D.	Rutherford Avenue Parcel

FIGURE

4.24

Joint Development Parcels Future Conditions Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 1200 Feet



Nashua Street Parcel.

Feasibility And Access: Residual land on the Nashua Street parcel subsequent to the construction of Scheme Z has an area of 2.3 acres with a frontage along Nashua Street of 497 feet. The height of the Storrow connector viaduct on the south side is approximately 32 feet. Parcel development may occur above and below ground without physical encumbrance from the highway. The only impacts to joint development are at the parcel edges.

The parcel has two principal exposures. One is west toward Nashua Street, the other north toward the Charles River. Vehicles could access/egress the development and its garage from Nashua Street. The most suitable locations for service areas are at the south, near Ramps CN-S and S-CS, and east, adjacent to the MBTA railroad tracks.

Pedestrian Circulation: Both sidewalks on Nashua Street accommodate the pedestrians introduced by the joint development, and those of the planned surrounding developments, but require the addition of new street furniture, lighting, and landscaping. The parcel has good physical and visual exposure to pedestrians.

Parcel Environment: Joint development on this parcel extends the character of the North Station EDA along Nashua Street to the Charles River. Nashua Street has development on both sides that creates a continuous mosaic of buildings and active street frontages from the Bulfinch Triangle to the riverside park. The new joint development is adjacent to the Boston Thermal Minot Station, the Registry Building, and the Suffolk County Jail, benefiting these existing buildings as well as the future joint development.

Air Rights Garage Parcel.

Feasibility And Access: The Storrow connector viaduct is approximately 30 feet east of the garage. The principal access to the garage is from Nashua Street through the above-mentioned Nashua Street development. The garage has approximately 580 spaces and requires two means of access/egress that combine into one connection with Nashua Street.

Lomasney Way Parcel.

Feasibility And Access: No joint development is feasible on this site because vehicular access to service the development cannot be provided from either Lomasney Way or Martha Road. Moreover, the boat section in this corridor limits joint development below ground.

4.2.5(b) Alternative 8.1D Mod 5

Spaulding Rehabilitation Hospital is taken in this alternative, so that the parcel on the north is 100 feet from the Charles River. Two tunnels, L-N and L-CS, are located beneath the site. A ventilation building with a footprint of 22,275 sf is on the northern riverbank, and is 60 feet high, with eight exhaust-air discharge stacks. Ramp N-S, from I-93 southbound to Storrow Drive, defines the southern boundary of the parcel and is on viaduct descending from 23 feet to approximately 16 feet across the southern boundary of the parcel.

This alternative allows, on the Nashua Street parcel, the development potential to exist above ground only, with good visual and physical exposure to pedestrians and vehicles. The air rights garage parcel is developed in a manner similar to its potential in Scheme Z. The Lomasney Way parcel is not feasible for joint development.

Nashua Street Parcel.

Feasibility And Access: The joint development potential is essentially above ground. Most of the parcel below ground is encumbered by tunnels that prevent feasible development. On the southern portion of the parcel, Ramp S-N in viaduct encumbers joint development.

The parcel's residual area is 3.3 acres with a frontage along Nashua Street of 541 feet. Development to a height of 250 to 300 feet, with an FAR of 8 to 10, is possible at the southern end of the parcel for 72 percent of the total site area. The remainder of the site could be developed to a height of 155 feet with an FAR 8 to 10. At the northern end of the parcel nearest the river a parcel remains with a permitted development height of 125 to 155 feet, and has exposure to the planned recreational areas of the Charles River Basin. Limited possibilities exist for its development, however, due to the ventilation building.

The joint development affects the height of the ventilation building stacks. It could be necessary to extend the height of the stacks above the abutting joint development if it is developed after construction of the ventilation building. This will be the responsibility of the developer.

Service vehicles gain access to the development from Nashua Street. It is possible to group the service areas of both the ventilation building and the joint development by locating their docking facilities in adjacent zones with a single access from Nashua Street. As the principal exposures of the parcel are west toward Nashua Street and north toward the Charles River, the likely locations of building service areas are at the south end of the site near Ramp S-N, and at the north directly opposite the ventilation building.

Pedestrian Circulation: Sidewalks on both sides of Nashua Street accommodate the pedestrian demands of the joint development and future surrounding developments, but require new landscape additions to facilitate pedestrian passages. The proposed buildings of the new Boston Garden development permit pedestrian movement between Causeway Street and the joint development parcel, passing beneath elevated Ramp S-N. This further improves the pedestrian exposure of the parcel by completing a connection to the future pedestrian network between Causeway Street, the Charles River, and buildings on the west. If, however, the zone adjacent to Ramp S-N is determined to favor service access for heavy vehicles, the separation between pedestrians and vehicles must be carefully designed to avoid additional impacts.

Parcel Environment: Joint development for Alternative 8.1D Mod 5 extends the character of the North Station EDA along Nashua Street to the Charles River, creating a continuous mosaic of buildings and active street frontages on both sides of the street between downtown Boston and the riverside park.

At the permitted height of development (between 155 and 250 feet), views are of the surrounding residential and institutional areas. In the foreground of views to Charlestown is a view of the proposed cable-stayed bridge supporting I-93 over the Charles River. At the above heights, the building is highly visible from the surrounding communities as well as from the immediate vicinity.

Air-Rights Garage.

Feasibility And Access: The size of the air rights garage parcel in this alternative is 0.5 acre. The principal point of access to the garage is from Nashua Street through the above-mentioned Nashua Street development. The garage accommodates 580 cars and requires two points of access/egress. Most garage users wanting to reach buildings in the North Station EDA or the proposed riverside park can do so from the Nashua Street sidewalk, because a proposed pedestrian passage is provided through the Nashua Street joint development parcel, increasing further the public exposure of this parcel.

Pedestrian Circulation: Pedestrians moving between North Station and the proposed riverside park use sidewalks on both sides of Nashua Street. Additional crosswalks may be required by the new

development. Landscape design creates a suitable pedestrian environment. The joint development enjoys direct exposure to pedestrians between North Station and the proposed park.

Parcel Environment: The garage in this location is entirely fitting to the North Station EDA desired by the City of Boston.

Lomasney Way Parcel.

Feasibility And Access: This corridor of land is not feasible for joint development. The additional encumbrance of streets, viaducts, and tunnels of this alternative, beyond those of Scheme Z, make it unfeasible for new joint development.

Rutherford Avenue Parcel.

Feasibility And Access: The area of this parcel is approximately 7 acres. Ramp S-N is in tunnel in the southeast portion of the parcel. This prevents a subgrade use in this portion, and demands that above-grade development is coordinated with the structure of the tunnel. The general industrial use of this parcel is not substantially affected.

Pedestrian circulation and the parcel environment are not affected by this alternative.

4.2.5(c) Reduced River-Tunnel Alternative

Under the Reduced River-Tunnel Alternative, Ramp N-S is approximately 32 feet above ground between the high-rise buildings of the new Boston Garden development and the Nashua Street joint development parcel. Ramps CN-L and L-CS are in tunnel under the parcel, and a ventilation building is at the southern end of the parcel, underground, except for an air-intake shaft and three exhaust-air discharge stacks. The Spaulding Hospital is taken and the site is redeveloped for a new use. Ramps S-N and N-S come to grade in the Lomasney Way/Martha Road corridor and meet other local and through streets as tunnels or surface roads.

The Reduced River-Tunnel Alternative has similar effects on the physical envelope of joint development areas as Scheme Z and Alternative 8.1D Mod 5. There are, however, characteristics of this alignment that cause unique impacts.

Nashua Street Parcel.

Feasibility And Access: The area of the Nashua Street parcel is approximately 3.8 acres with a frontage on Nashua Street of approximately 725 feet. Current zoning regulations allow development to a height of 250 to 300 feet, FAR 8 to 10 at the southern end of the parcel on 2.4 acres (63 percent of the site area), and 155 feet FAR 8 to 10 for 1.4 acres (37 percent of the total site area) at the northern end. At the southern end of the parcel, a ventilation building is built below ground, with two air-exhaust discharge stacks and an air-intake shaft above ground. The height of the stacks and the location of the air intake may be affected by the surrounding joint development at the expense of the developer.

Joint development opportunities on this parcel exist both above and below ground. Ramp L-CS passes beneath the parcel, but does not render a subgrade use unfeasible. A land duct from ventilation building 8 adds to the Project elements encroaching on the parcel.

Pedestrian Circulation: Pedestrians moving between North Station and the proposed riverside park use sidewalks on both sides of Nashua Street. Pedestrians in the area due to the new joint development also use these sidewalks, which require a new design for a suitable pedestrian environment. The joint development enjoys direct exposure to pedestrians between North Station and the proposed riverside park.

Parcel Environment: Joint development on this parcel uses land between the North Station EDA and the Spaulding building site. This improves the environment of these buildings and Nashua Street alike. The development commands views predominantly east and west. The prominence of the joint development in the area is reduced to belong rather to Nashua Street, than to a landmark building in the foreground of the North Station EDA.

Air Rights Garage.

Feasibility And Access: The size of the air rights garage is approximately 1.8 acres. Its principal access/egress is from Nashua Street through the above-mentioned joint development. The garage accommodates approximately 580 cars and requires two means of access/egress. Garage users wanting to reach buildings of the North Station EDA or the proposed riverside park can do so from the Nashua Street parcel.

The movement of pedestrians from the air rights garage to ground level is accomplished on the west side of the garage, alongside the Nashua Street parcel, and/or through it. Vehicular access, too, is achieved from Nashua Street. Circulation through the five levels is a function of design; no restrictive impact results from the Reduced River-Tunnel Alternative.

Pedestrian Circulation: Pedestrians gain access to this parcel via the Nashua Street parcel or in the margin between this parcel and the garage. Those people coming from the high-rise of the new Boston Garden development can pass beneath elevated Ramp N-S into the likely service zone of the Nashua Street parcel joint development. They can then access the garage through the Nashua Street building, or through vertical circulation directly into the garage.

Parcel Environment: The garage in this location is entirely fitting to the North Station EDA, desired by the City of Boston.

Lomasney Way Parcel.

Feasibility And Access: Because of the several highway tunnels through this corridor no joint development is possible.

4.2.5(d) Non-River-Tunnel Alternative

Two aspects of this alternative constitute the reconfiguration and reparcelsation of land, and demand that previous surrounding development assumptions be reconsidered: (1) two elevated viaducts, N-S and S-N, separate the EDA from land on its immediate north, and reduce the air rights garage area by some 49 percent; (2) Nashua Street is realigned to the east and intersects Ramp CN-L with traffic from Central Artery northbound to Leverett Circle.

The realignment of Nashua Street effects an exchange of land from the existing parcel east of Nashua Street to an approximately 50 percent smaller parcel west of Nashua Street. The new parcel includes Ramp CN-L which comes to grade at Nashua Street, a ventilation building, and Ramp L-CS. These factors combine to reduce joint development opportunities on the new Nashua Street parcel for this alternative, as well as in the air rights garage which requires access from the west. The Lomasney Way parcel remains a difficult joint development parcel under current assumptions.

Nashua Street Parcel.

Feasibility And Access: The new Nashua Street parcel is approximately 1.4 acres. The buildable area is increased if the air rights over CN-L are developed. The parcel frontage on Nashua Street is approximately 530 feet, and the physical envelope of the building is farther from the MBTA railroad tracks on the opposite side of Nashua Street.

The zoning assumptions for this new parcel result from the partly overlapping current zoning districts that govern the Nashua Street parcel today. This permits development to a height of 250 to 300 feet, with an FAR of 8 to 10, for 50 percent of the site in the southern portion, and 155 feet with an FAR of 8 to 10 for 50 percent at the northern end of the site.

In the approximate center of the parcel is a ventilation building, built below ground. It has two exhaust-air discharge stacks and an air-intake shaft that require construction and planning coordination with the joint development. If the parcel is developed after the ventilation building, it could be necessary to extend the stacks above the physical envelope of the new abutting joint development, at the expense of the developer.

Joint development exists both above and below ground on this parcel. Ramps CN-L and L-CS are in tunnel underneath the parcel. In the event that a subgrade garage development is desired, it is limited by the location of the tunnels, but not prevented or rendered unfeasible.

Vehicular access is located in the loading area for the ventilation building off Nashua Street. Vehicles can access/egress south of the parcel to Nashua Street, and exit only north to Nashua Street. A service core is effectively created for the enclave of the Registry building, the Suffolk County Jail, and the joint development parcel including the ventilation building.

The principal exposures of the parcel are east towards Nashua Street, and north toward the Charles River. The best location for service facilities are west, in the service zone of the other buildings in the enclave.

Pedestrian Circulation: The parcel environment restricts access to pedestrians at grade, due to Ramp CN-L, which enters Nashua Street at the northwest corner of the parcel, and the ventilation building on the southwest corner of the parcel.

The pedestrians moving between North Station and the riverside use the direct passage of the landscaped corridor between Nashua Street and the MBTA railroad tracks. The joint development parcel does not enjoy direct exposure to pedestrians between North Station/new Boston Garden and the proposed riverside park. Those pedestrians using the Nashua Street west sidewalk in direct contact with the joint development encounter at least two crosswalks on Nashua Street. The alternate pedestrian route to Leverett Circle is between the Registry building front entrance and Ramp CN-L.

Parcel Environment: The joint development of this parcel consolidates into one enclave the three buildings of the North Station EDA: the Registry building, the Suffolk County Jail, and the potential joint development. It continues the character of the EDA, although the pattern of buildings is interrupted by the elevated viaducts and realigned Nashua Street, and the pattern of development in this area of Boston, vis-a-vis buildings on both sides of streets, changes to buildings on one side only. The size of the new parcel is consistent with the size of existing surrounding parcels. Views are captured from the future joint development in all directions.

Air Rights Garage.

Feasibility And Access: The feasibility of developing the air rights garage is diminished because Ramps S-N and N-S occupy much of the zoning envelope of the garage. These ramps reduce the area of the garage parcel by some 49 percent and condense vehicular circulation inside the garage. Moreover, access and egress from Nashua Street are modified. Vehicles must climb to approximately 33 feet above the MBTA railroad tracks by means of either a helical ramp or parallel ramps. As with the other new design alternatives, two means of egress are preferable, although the need is diminished in the Non-River-Tunnel

Alternative, since the total number parking spaces is reduced from Scheme Z and the two river tunnel alternatives.

Pedestrian Circulation: Pedestrian access between North Station and the Charles River requires internal circulation through what remains of the zone between Nashua Street and the garage. This is designed for pedestrian connections into the surrounding areas, including the proposed riverside park and the North Station EDA.

Parcel Environment: In addition to the encroachment of ramps and the congested internal circulation, the realignment of Nashua Street exposes the air rights garage to Nashua Street and to the commercial environment of the North Station EDA. Since the garage is an air rights building that is set back from the edge of Track 12, it does not have an impact at street level.

Lomasney Way Parcel.

Feasibility And Access: Joint development potential exists in the portion south of the MBTA Green Line portal in the corridor between the west face of the Registry building and the east face of Charles River Park housing. It is relatively unencumbered by infrastructure. Due to tunnels, however, the development potential of this parcel exists entirely above ground. It is possible to gain access from Martha Road, Lomasney Way, or Nashua Street, although the latter would likely become the front of any building on this parcel.

Pedestrian Access: Pedestrians from Causeway Street approach the joint development from a Nashua Street crosswalk. Pedestrians from the new Boston Garden development approach from between high-rise buildings on Causeway Street. Alternately, pedestrians approach by Martha Road from Leverett Circle, or from Charles River Park housing and MGH. For every route, new landscape design assists the pedestrian environment.

Parcel Environment: Although it is not part of the North Station EDA, this development makes a positive contribution to adjacent buildings. It obscures views of the roads and viaducts in the corridor, and helps to define Nashua Street where several streets and driveways meet.

4.2.5(e) Summary

The size of the Nashua Street parcel differs with each design; however, the feasibility of development is unaffected. Scheme Z allows development both above and below ground. The ventilation building required by the alternatives limit its subgrade development to some extent. Only Alternative 8.1D Mod 5, with its tunnel placement, may make subgrade construction infeasible.

Development of the air rights garage parcel is possible with Scheme Z, Alternative 8.1D Mod 5, and the Reduced River-Tunnel Alternative. The ramps of the Non-River-Tunnel Alternative reduce the garage's capacity, circulation, and access/egress, making its development essentially infeasible.

Only the Reduced River-Tunnel Alternative allows development of the Lomasney Way parcel.

The Rutherford Avenue parcel is affected only by Alternative 8.1D Mod 5, which because of ramp placement allows only above-ground development.

The Project preserves joint development potentials on these four parcels to varying degrees, as noted in Table 4.15.

Table 4.15

COMPARISON OF JOINT DEVELOPMENT IMPACTS

Parcel	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
Nashua Street	<i>No Impact</i> Development potential above and below ground. Two-tier viaduct on south. Spaulding Hospital on north.	<i>Moderate Impact</i> Development potentials are above ground only. Viaduct on south. Ventilation building on north. Tunnels below ground.	<i>Moderate Impact</i> Partial encumbrance of tunnel; partial encumbrance of ventilation building. Viaduct on south.	<i>Adverse Impact</i> New parcel. New Nashua Street alignment. Parcel size reduction 50 percent; encumbrances of ventilation building, ramp, and tunnel.
Air Rights Garage	<i>No Impact</i> Two-tier viaduct on south. Access from Nashua Street.	<i>No Impact</i> One viaduct on south. Access from Nashua Street.	<i>No Impact</i> One viaduct on south. Access from Nashua Street.	<i>Adverse Impact</i> Two viaducts on south. Parcel size reduction 49 percent; limited vehicle access from Nashua Street.
Lomasney Way	<i>Severe Impact</i> No development potentials.	<i>Severe Impact</i> No development potentials.	<i>Severe Impacts</i> No development potentials.	<i>Moderate Impact</i> Development potentials exist above ground, south of the MBTA Green Line portal.
Rutherford Avenue	<i>No Impact</i> No development encumbrance.	<i>Moderate Impact</i> Partial development encumbrance due to tunnel.	<i>No Impact</i> No development encumbrance.	<i>No Impact</i> No development encumbrance.

Source: Bechtel/Parsons Brinckerhoff

4.3 AIR QUALITY

4.3.1 Introduction

This section describes the results of an analysis of the air quality impacts of the three new design alternatives. Air quality levels of each alternative are compared with future conditions of associated with Scheme Z, and with applicable National and State Ambient Air Quality Standards and guidelines. Under a protocol developed with DEP and EPA, analyses were completed for the years 2001 and 2010. The following information is included in this section: a description of existing air quality levels; an analysis of the three alternatives on regional levels of carbon monoxide, volatile organic compounds, nitrogen oxides, and particulate matter (mesoscale analysis); an investigation of the impact of the proposed alternatives on carbon monoxide levels at critical locations within neighborhoods along the alignment (microscale analysis); and an analysis of impacts associated with proposed tunnel ventilation systems on carbon monoxide, nitrogen dioxide, and particulate matter levels.

4.3.2 Affected Environment

4.3.2(a) Applicable Air Quality Standards And Guidelines

Seven air pollutants have been identified by the U.S. EPA as being of concern nationwide: carbon monoxide (CO), hydrocarbons (HC), referred to as volatile organic compounds (VOC), nitrogen oxides (NO_x), ozone (O₃), particulate matter (PM₁₀), sulfur oxides, and lead. National and State Ambient Air Quality Standards (AAQS) have been established for CO, nitrogen dioxide (NO₂), O₃, PM₁₀, sulfur dioxide, and lead (see Table 4.16), and these standards have not been changed since the publication of the 1991 FSEIS/R. VOC levels are used as an indicator of regional O₃ levels, for they react in the atmosphere with NO_x to form O₃.

In addition, the Massachusetts DEP has established a site-specific short-term (1-hour) "policy level" for NO₂ of 320 micrograms per cubic meter (μg/m³)(DEP, April 20, 1978). A source is considered to have a "significant impact" under this policy guideline if it is estimated to cause an increase in 1-hour NO₂ levels of 10 percent or more of the policy guideline, i.e., 32 μg/m³.

Also, Massachusetts DEP air pollution control regulations (310 CMR 7.38) require that, prior to construction of a major roadway tunnel ventilation system in the Metropolitan Boston Air Pollution Control District, it must be certified that when operated the project will not:

- cause or exacerbate a violation of any National or Massachusetts AAQS
- cause or exacerbate a violation of the Massachusetts DEP 1-hour NO₂ policy level
- result in an actual or projected increase in the total amount of nonmethane HC (VOCs) measured within the project area when compared with the no-build alternative

In addition, on October 8, 1992, EPA approved the Commonwealth of Massachusetts regulation for certifying roadway tunnel ventilation systems in the Metropolitan Boston Air Pollution Control District as a revision to the Massachusetts State Implementation Plan (SIP) (57 FR 46310-46312). In this final rule, EPA concluded that tunnel ventilation systems are not stationary sources of air pollution subject to Prevention of Significant Deterioration (PSD) or New Source Review permitting requirements identified in the Clean Air Act Amendments (CAAA) of 1990 or in the Commonwealth of Massachusetts Regulation 310 CMR 7.02.

Finally, the 1990 CAAA require that Federally funded transportation projects located within a designated CO or O₃ nonattainment area must result in the elimination or reduction in the number and severity of

violations of the AAQS for CO in the area substantially affected by the project. In addition, these projects must assist in the reduction of VOCs and CO emissions in the area, and seek to avoid any increase in these emissions over year 1990 baseline emission levels for these pollutants. The Boston region has been designated as a nonattainment area for both CO and O₃.

4.3.2(b) Pollutants For Analysis

As described in the 1991 FSEIS/R, of relevance to evaluating the impact of the alternatives are those pollutants that can be traced principally, or in large measure, to motor vehicles. These include CO, VOCs, NO_x, and O₃. In addition, although motor vehicles account for a small portion of total PM₁₀ levels, diesel-powered vehicles emit relatively higher amounts of PM₁₀ compared to gasoline-powered vehicles.

Based on the above considerations and the nature of the dispersion and reactions of these criteria pollutants in the atmosphere, CO concentrations were estimated using a detailed microscale mobile source impact analysis, a detailed ventilation system impact analysis, and a regional (mesoscale) impact analysis; NO_x and VOCs were analyzed on a mesoscale basis to assess their potential effect on regional O₃ levels; NO₂ emissions from the proposed ventilation buildings were analyzed on a microscale basis to permit direct comparison with the 1-hour DEP policy level and the annual AAQS for NO₂; and PM₁₀ impacts were estimated both on a microscale basis, for the proposed ventilation buildings for the three new design alternatives, and on a regional (mesoscale) basis.

Finally, the emission of "noncriteria" toxic air pollutants (toxic pollutants for which criteria have not been established on which to base National AAQS) from motor vehicles is directly related to the level of VOCs emitted from such vehicles. To evaluate the potential changes in air toxic concentrations expected with each alternative, regional changes in VOC emissions with each alternative were compared against the base line (1990) levels and with projected Scheme Z levels for the years 2001 and 2010.

To demonstrate compliance of the alternatives with the 1990 CAAA, the following analyses were performed:

- CO levels were estimated at the most critical intersections that could be anticipated to be affected by the three new design alternatives. Since elevated CO levels are generally found at intersections, this analysis evaluated those locations where Project changes had the potential to cause or exacerbate a violation of the State and National AAQS.
- Regional emissions of CO, VOCs, NO_x, and PM₁₀, generated in the study area, were estimated for each of the three new design alternatives and Scheme Z and compared to emission levels in 1990.
- The potential impacts of each proposed ventilation building associated with the new alternatives on the existing CO, NO₂, and PM₁₀ levels were estimated in order to demonstrate compliance with the AAQS and the Massachusetts DEP NO₂ Policy Guideline.

4.3.2(c) Existing Ambient Air Quality Levels

DEP and EPA recommend that assessments of the air quality impacts of proposed highway projects be based on the most recently available 3 years of ambient air quality monitoring data representative of the project area. The most recent 3 years of data available from the DEP ambient air quality monitoring network (1989, 1990, and 1991) were used to describe existing ambient air quality levels in the Boston area for CO, PM₁₀, NO₂, and O₃. The highest monitored levels in the vicinity of the Project area are summarized in Table 4.17. A more extensive description of the monitored data and the location of the

Table 4.16

NATIONAL AND STATE AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Period	Primary ($\mu\text{g}/\text{m}_3$)	Primary (ppm)	Secondary ($\mu\text{g}/\text{m}_3$)
Carbon Monoxide (CO)	8-hour ^a	10,000	9.0	10,000
	1-hour ^a	40,000	35.0	40,000
Sulfur Dioxide (SO ₂)	Annual	80	0.03	1,300
	24-hour ^a	365	0.14	
	3-hour ^a			
Nitrogen Dioxide (NO ₂)	Annual	100	0.05	100
Ozone (O ₃)	1-hour ^b	35	0.125	235
PM ₁₀	Annual	50		50
	24-hour ^a	150		100
Lead (Pb)	3-month	1.5		1.5

Notes: a. Not to be exceeded more than once per calendar year.

b. Not to be exceeded more than one day per calendar year.

c. The MDEP has established a 1-hour guideline level of 320 $\mu\text{g}/\text{m}_3$ for NO₂.

Sources: EPA, National Primary and Secondary Ambient Air Quality Standards (40 CFR 50).
Massachusetts DEP, Massachusetts Ambient Air Quality Standards (Title 310), April 20, 1978.

Table 4.17

**HIGHEST AMBIENT AIR QUALITY MONITORED LEVELS
IN THE VICINITY OF THE PROJECT AREA
(1989 TO 1991)**

Pollutant	Site	Time Period	Concentration	NAAQS
Carbon Monoxide	340 Bremen Street (East Boston)	1-hour	12.6 ppm	35 ppm ^a
		8-hour	8.9 ppm	9.0 ppm ^a
PM ₁₀	One City Square (Charlestown)	24 hour	96 µg/m ³	150 µg/m ³ ^a
		annual mean	38 µg/m ³	50 µg/m ³
Nitrogen Dioxide	340 Bremen Street	1-hour	470 µg/m ³	320 µg/m ³ ^b
		annual mean	60 µg/m ³	100 µg/m ³
Ozone	Chelsea	1-hour	0.137 ppm	0.125 ppm ^c

- Notes: ^a Not to be exceeded more than once per year.
^b DEP 1-hour NO₂ policy guideline is 320 µg/m³, not to be exceeded more than once per year.
^c Not to be exceeded more than one day per calendar year.

Sources: Air Quality Data Reports for 1989 and 1990, Commonwealth of Massachusetts Department of Environmental Protection, Division of Air Quality Control; 1991 Annual Report of Air Quality in New England, Environmental Protection Agency, Region I, May 1992

monitors is presented in Section 4 of the Air Quality Appendix. These data indicate that there are no violations of the National and State AAQS for CO, NO₂, and PM₁₀ at any of the monitoring stations during the 3-year period. In the case of O₃, levels in excess of the standard have been recorded at three of the five monitoring stations during the same 3-year period.

4.3.2(d) Changes Since The FSEIS/R

The air quality impact assessment presented in the 1991 FSEIS/R was based on DEP monitoring data for the years 1986, 1987, and 1988. These data indicated that concentrations in excess of the AAQS for O₃ were recorded at stations in Chelsea and Sudbury, the closest monitoring stations to the Project area. These data also indicated that there were violations of the 8-hour CO AAQS at the North Washington Street monitoring station in 1986, and that maximum 1-hour NO₂ concentrations were greater than the DEP NO₂ policy level in 1986 and 1987 at the Kenmore Square monitoring station, and in 1986 at the Bremen Street monitoring station. No other violations of the AAQS for any pollutant for which AAQS have been established at the monitoring locations were recorded.

Compared to air quality levels reported in the 1991 FSEIS/R for the period 1986 through 1988, air quality levels reported in this DSEIS/R, based on the period 1989 through 1991, have improved since the previous reporting period.

4.3.3 Impacts Of The Alternatives

4.3.3(a) Project Emissions

The relative air quality impacts of the alternatives are directly related to their effects on vehicular emissions. Localized, areawide, and ventilation building air quality impacts all result from motor vehicle emissions. Changes in traffic volumes, traffic patterns, vehicular speeds, and roadway configurations affect both the amount of pollution generated and how it is dispersed within the affected area.

Emission Factors For CO, VOCs, And NO_x. EPA periodically updates its mobile source emissions estimation model to conform with the most currently available engine test data, to reflect current vehicle control technologies, and to assess the effect of mandated emission control requirements. In this study, motor vehicle emission rates for CO, VOCs, and NO_x were estimated using the MOBILE 5a version of the EPA Mobile Source Emission Factor Model (EPA-AA-TEB-92), the most current available version. Since the MOBILE 5a version currently does not produce idling emission factors (needed for the CO microscale modeling), the MOBILE 4.1 version was used to estimate idling emission factors.

Vehicular emissions are affected by vehicular speed, ambient temperature, engine temperature (thermal state), vehicle age and mileage distribution, inspection and maintenance programs, fuel volatility, and other localized parameters. While the selection criteria for most of the input parameters were established in the original 1989 Protocol, some parameters have been revised to reflect changes mandated by the 1990 CAAA, to include new options available in the current version of the model, and to be consistent with the 1990 emission inventory prepared by DEP. Detailed discussions of the assumptions and parameters that were used in this analysis are provided in Section 5 of the Air Quality Appendix.

Since the future emission factors forecast by MOBILE 5a (and MOBILE 4.1) are different from the ones forecast in the 1991 FSEIS/R using the MOBILE 4 version of the model, the air quality levels for Scheme Z were reanalyzed using the new procedures in order to permit a direct comparison with the three alternatives.

Emission Factors For PM₁₀. Motor vehicle-related sources of PM₁₀ include emissions from vehicle tailpipes, brakes, tire wear, and re-entrained road dust. PM₁₀ emissions from tailpipes, brakes, and tire

wear were estimated using the EPA-PART program *Emissions from Mobile Sources* (EPA 460/3-85-007). Fugitive dust emissions for re-entrained road dust were estimated using the most recent version of the EPA *Compilation of Air Pollutant Factors AP-42*. These emission factors are the same as the ones used in the 1991 FSEIS/R.

4.3.3(b) Estimated Areawide (Mesoscale) Pollutant Emissions

The total quantities of motor vehicle-related pollutants emitted in the study area (i.e., the tons of pollutants emitted each day) were estimated to provide an indication of the change in air quality in the region, including relative changes in the levels of CO, VOCs, NO_x, PM₁₀, and O₃.

The emissions generated under the three alternatives are compared to those generated under Scheme Z for the years 2001 and 2010, and to those generated in the 1990 base year. This information is used to determine the conformity of each alternative with the 1990 CAAA and the SIP.

Study Areas. The study area is the same as the study area in the 1991 FSEIS/R, which includes Ramp CL, a feature of all new alternatives. All major highways, roadways, and local streets within the study area are included in this assessment. Figure 4.25 outlines the six major geographic zones that were analyzed within the overall roadway network.

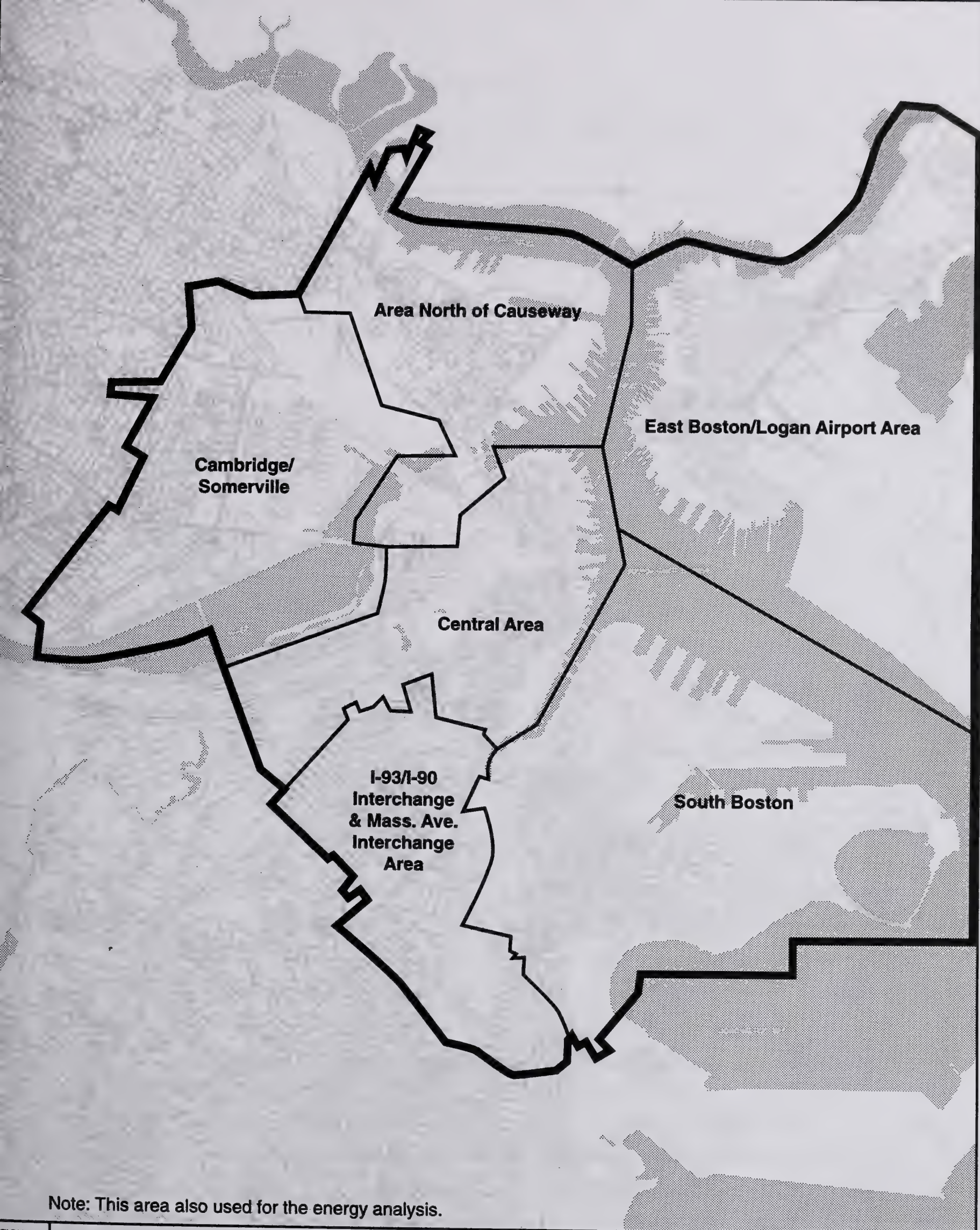
Traffic Data. VMT, VHT, average travel speed, and vehicle classification for the different roadways were estimated for each of the six major geographic zones as part of the overall Project traffic analysis. The traffic data used to estimate these emissions for 1990, 2001, and 2010 are provided in Section 6 of the Air Quality Appendix.

Estimated 1990 Baseline Year Areawide Emissions. Estimated peak daily areawide emissions of CO, VOCs, NO_x, and PM₁₀ are provided in Table 4.18 (annual areawide emissions are provided in Section 6 of the Air Quality Appendix). The results indicate that, approximately 118 tons per day of CO, 12.4 tons per day of VOCs, 8.9 tons per day of NO_x, and 6.8 tons per day of PM₁₀ were emitted by motor vehicles using the roadway network in the study area in 1990. Of these totals approximately 73 percent of CO, 68 percent of VOCs, 56 percent of NO_x, and 88 percent of PM₁₀ were emitted from motor vehicles using local streets in the study area.

Estimated Future Areawide Emissions For 2001. Estimated peak daily areawide emissions of CO, VOCs, NO_x, and PM₁₀ for Scheme Z and the three new design alternatives for the year 2001 are shown in Table 4.19. When compared to the 1990 levels, the estimated VMT are expected to increase 22 percent, VHT are expected to increase 10 percent, and average network speed is expected to improve 12 percent with Scheme Z.

The results indicate that with Scheme Z, approximately 77.3 tons per day of CO, 6.3 tons per day of VOCs, 6.9 tons per day of NO_x, and 7.0 tons per day of PM₁₀ would be emitted by motor vehicles using the roadway network in the study area. Of these totals approximately 68 percent of CO, 64 percent of VOCs, 48 percent of NO_x, and 87 percent of PM₁₀ will be emitted by vehicles travelling in local streets on the study area.

Pollutant emission levels with Scheme Z in 2001 are estimated to result in a reduction of 34 percent in CO, 50 percent in VOCs, and 22 percent in NO_x compared to 1990 levels. In the case of PM₁₀, a 5 percent increase is anticipated. The reductions in CO, VOC, and NO_x emissions are due to the expected cleaner vehicles in the future as mandated by Federal and State regulations. In the case of PM₁₀, most of the emissions are due to roadway dust that is resuspended by vehicle movement. As a consequence, the effect of cleaner vehicles has minimal impact toward PM₁₀ emission reductions.



Note: This area also used for the energy analysis.

FIGURE

4.25

Affected Zones For Mesoscale Air Quality Analysis

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 800 1600 3200 4800 FEET





Table 4.18

PEAK DAILY EMISSION BURDENS IN THE STUDY AREA FOR THE YEAR 1990
(tons per day)

Affected Zone	CO	VOC	NO_x	PM₁₀
Area North of Causeway Street				
highways and ramps	8.71	1.10	1.05	0.22
covered highways	0.00	0.00	0.00	0.00
local streets	9.11	0.92	0.57	0.73
Central Area				
highways and ramps	10.25	1.30	1.27	0.26
covered highways	2.54	0.32	0.31	0.05
local streets	19.55	1.91	0.95	1.37
I-93/I-90 Interchange				
highways and ramps	7.24	0.92	0.92	0.19
covered highways	0.00	0.00	0.00	0.00
local streets	11.61	1.16	0.82	0.83
South Boston				
highways and ramps	0.00	0.00	0.00	0.00
covered highways	0.00	0.00	0.00	0.00
local streets	16.94	1.62	1.04	1.00
East Boston				
highways and ramps	2.09	0.27	0.28	0.06
covered highways	0.83	0.11	0.14	0.02
local streets	6.96	0.72	0.53	0.75
East Cambridge				
highways and ramps	0.00	0.00	0.00	0.00
covered highways	0.00	0.00	0.00	0.00
local streets	22.24	2.09	1.09	1.30
Local Street Subtotals	86.42	8.41	5.00	5.99
Hwys./Ramps/Cov. Hwys. Subtotals	31.67	4.01	3.96	0.80
Totals	118.09	12.43	8.95	6.79

Source: Bechtel/Parsons Brinckerhoff

PEAK DAILY EMISSION BURDENS IN THE STUDY AREA FOR THE YEAR 2001
(tons per day)

Affected Zone	CO				VOC				NO _x				PM ₁₀			
	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel
Area North of Causeway Street																
highways and ramps	4.97	4.69	5.75	4.61	0.46	0.42	0.50	0.43	0.78	0.66	0.77	0.71	0.23	0.19	0.22	0.20
covered highways	0.77	1.44	1.08	1.14	0.08	0.14	0.10	0.11	0.15	0.25	0.17	0.20	0.03	0.05	0.04	0.04
local streets	4.77	4.39	4.26	4.40	0.36	0.33	0.32	0.33	0.37	0.33	0.32	0.33	0.77	0.67	0.67	0.67
Central Area																
highways and ramps	4.73	4.79	4.67	4.69	0.42	0.42	0.42	0.42	0.66	0.66	0.66	0.66	0.19	0.19	0.19	0.19
covered highways	2.72	3.14	2.99	2.93	0.27	0.30	0.29	0.28	0.48	0.51	0.51	0.51	0.10	0.10	0.10	0.10
local streets	12.11	11.73	11.68	11.71	0.91	0.88	0.88	0.88	0.70	0.68	0.68	0.68	1.51	1.47	1.47	1.47
I-93/I-90 Interchange																
highways and ramps	6.58	6.03	6.10	6.07	0.53	0.50	0.50	0.50	0.70	0.70	0.70	0.71	0.20	0.20	0.20	0.20
covered highways	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
local streets	8.26	8.35	8.26	8.39	0.65	0.66	0.65	0.66	0.61	0.61	0.61	0.61	0.99	1.00	0.99	0.99
South Boston																
highways and ramps	0.50	0.49	0.50	0.50	0.04	0.04	0.04	0.04	0.07	0.07	0.07	0.07	0.02	0.02	0.02	0.02
covered highways	1.33	1.30	1.30	1.30	0.14	0.14	0.14	0.14	0.29	0.29	0.29	0.29	0.06	0.06	0.06	0.06
local streets	9.75	9.80	9.82	9.78	0.77	0.77	0.77	0.77	0.66	0.66	0.66	0.66	1.02	1.03	1.03	1.03
East Boston																
highways	2.17	2.22	2.19	2.18	0.20	0.20	0.20	0.20	0.34	0.34	0.34	0.34	0.10	0.10	0.10	0.10
covered ramps	0.47	0.47	0.49	0.48	0.05	0.05	0.05	0.05	0.10	0.10	0.10	0.10	0.02	0.02	0.02	0.02
local streets	4.98	5.03	4.94	5.06	0.38	0.38	0.38	0.38	0.30	0.30	0.30	0.30	0.59	0.58	0.59	0.59
East Cambridge																
highways and ramps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
covered highways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
local streets	13.19	13.11	13.15	13.27	1.00	1.00	1.00	1.01	0.74	0.73	0.73	0.73	1.35	1.35	1.35	1.35
local street subtotals	53.07	52.41	53.10	52.60	4.06	4.02	4.00	4.03	3.37	3.31	3.31	3.31	6.23	6.09	6.10	6.10
hwys./ramps/covered hwys. subtotal	24.24	24.58	25.06	23.91	2.19	2.21	2.24	2.17	3.58	3.59	3.61	3.59	0.94	0.94	0.95	0.94
Totals	77.31	76.99	77.17	76.50	6.26	6.23	6.24	6.21	6.95	6.90	6.92	6.90	7.17	7.02	7.05	7.04

Source: Bechtel/Parsons Brinckerhoff

Estimated Future Areawide Emissions For Year 2010. Estimated peak daily areawide emissions of CO, VOCs, NO_x, and PM₁₀ for Scheme Z and the three new design alternatives for the year 2010 are shown in Table 4.20. When compared to 1990 levels, the estimated VMT for Scheme Z are expected to increase 40 percent, VHT are expected to increase 45 percent, and average network speed is expected to decrease 3 percent.

The results indicate that with Scheme Z approximately 95.6 tons per day of CO, 6.7 tons per day of VOCs, 7.4 tons per day of NO_x, and 8.2 tons per day of PM₁₀ would be emitted by motor vehicles using the roadway network in the study area. Of these totals approximately 67 percent of CO, 65 percent of VOCs, 49 percent of NO_x, and 86 percent of PM₁₀ will be emitted by vehicles travelling in local streets on the study area.

When Scheme Z for the year 2010 is compared to the 1990 emission levels, the results indicate a reduction of 19 percent in CO, 45 percent in VOCs, and 17 percent in NO_x. In the case of PM₁₀, a 20 percent increase is anticipated.

Comparison Of Alternatives. Areawide emissions for each of the alternatives are slightly lower than the estimated emissions with Scheme Z due to lower VMT resulting from the elimination of the double crossing. As a consequence, all alternatives are anticipated to have marginal air quality improvements when compared to Scheme Z (1 to 2 percent). When compared to each other, the emissions with the alternatives (for all pollutants analyzed) are within 1 percent of each other.

On an areawide basis, emission levels do not vary substantially among the three new design alternatives.

4.3.3(c) Mobile Source Carbon Monoxide Impacts

A mobile source microscale analysis was completed to estimate ambient levels of CO near 23 major congested intersections which could be anticipated to be affected by the alternatives. The analysis was designed to determine whether any of the alternatives would cause or exacerbate an exceedance of the CO AAQS. The analysis also compared estimated CO levels at these intersections among the alternatives and to Scheme Z to determine which alternative would result in the smallest increase in CO levels. Due to the previously described changes in the forecasting emission models and mandates of the 1990 CAAA, Scheme Z was reanalyzed in order to permit a direct comparison with the alternatives.

One-hour and 8-hour CO levels were estimated at each intersection for the years 2001 and 2010.

Modeling Methodology. The CO modeling analysis for the 23 critical intersections in the study area followed the same general methodology used in estimating intersection CO levels in the 1991 FSEIS/R. The most recent version of the EPA mobile source emission factor model (MOBILE 5a) was used to estimate vehicular emissions rather than MOBILE 4 which was used in the 1991 FSEIS/R. The CAL3QHC (Version 2.0) air quality dispersion model (EPA-454/12-92-006) was used to estimate ambient pollutant concentrations at each receptor location analyzed. Locations at which estimates were completed are identified on Figure 4.26, and include the locations where, based on existing and estimated future traffic conditions, the greatest Project-related air quality impacts would be expected to occur.

The selection of the intersections analyzed and the principal inputs to the CAL3QHC model were made in consultation with EPA Region I and DEP, following the EPA *Guidelines for Modeling Carbon Monoxide at Roadway Intersections* (EPA-454/R-92-005). A detailed description of the methodology and assumptions used in this analysis is provided in Section 6 of the Air Quality Appendix. In order to estimate pollutant concentrations where maximum Project impacts are expected to occur, 10 to 18 receptor locations were modeled for each selected intersection.

Traffic Data. Traffic data for the analysis were derived from the traffic counts, speed data, and other information developed as part of the traffic analysis for this FSEIS/R. The 8-hour CO analysis was based on estimated traffic levels during the peak 8-hour traffic period (10:00 AM to 6:00 PM). Peak 1-hour concentrations of CO were obtained by dividing peak 8-hour CO levels by 0.6 to account for the observed fact that vehicle volumes, vehicle speeds, and meteorological conditions during the 8-hour period will vary from those that will persist for only 1 hour.

Meteorological Conditions. The transport and dispersion of pollutants emitted from motor vehicles are influenced by wind direction, wind speed, and the temperature profile of the atmosphere. Values for these parameters were chosen to result in reasonable worst case pollutant concentrations at each prediction site.

Background CO Levels. Estimation of total ambient air quality requires the inclusion of pollutant background levels. Background level is the component of the total concentration not accounted for directly through the microscale modeling analysis. Applicable background concentrations were added to the modeling results to obtain the total pollutant concentration at each receptor site for each analysis year. The background levels used in this analysis were developed following the same methodology as in the 1991 FSEIS/R, and are described in Section 6 of the Air Quality Appendix.

Estimated Future CO Levels Based On Microscale Modeling. The results of the CO microscale analysis are summarized in Tables 4.21 to 4.24. Provided are estimates of the highest 1-hour and 8-hour concentrations of CO for each of the 23 intersections analyzed for Scheme Z and the three new design alternatives for the years 2001 and 2010. The results of the analysis indicate that:

- One-hour and 8-hour CO concentrations in 2001 for all scenarios analyzed will be less than (in compliance with) the National and State AAQS of 35 ppm and 9 ppm at all locations analyzed. The maximum 1-hour and 8-hour CO concentrations (13.0 parts per million (ppm) and 7.8 ppm) were estimated near the intersection of North Washington and Commercial Streets for Scheme Z.
- One-hour and 8-hour CO concentrations in 2010 for all scenarios analyzed will be less than (in compliance with) the National and State AAQS of 35 ppm and 9 ppm at all locations analyzed. The maximum 1-hour and 8-hour CO concentrations (13.6 ppm and 8.1 ppm) were estimated near the intersection of North Washington and Commercial Streets for Scheme Z.

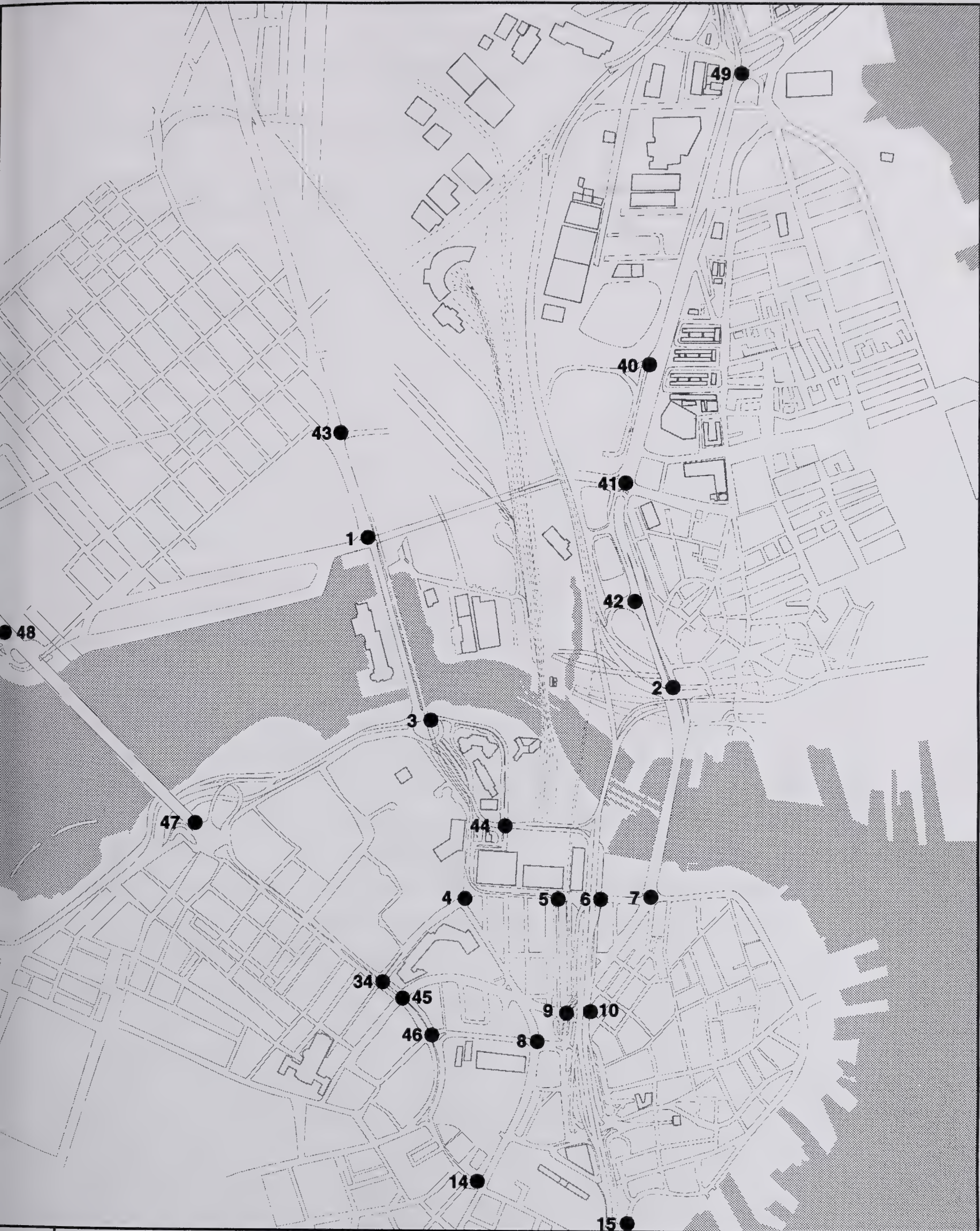
Comparison Of Alternatives. For the three new design alternatives, predicted CO levels at most of the 23 intersections analyzed are very similar to and slightly lower than the levels predicted for Scheme Z. The principal reasons for these slightly lower CO levels are better traffic operations in local and arterial streets associated with the three new design alternatives.

There are a few intersections where the 8-hour CO levels are substantially lower (better) than for Scheme Z. These include: City Square, Cambridge/New Sudbury Streets, and Cambridge/New Chardon Streets for all three alternatives; and Leverett Circle and Rutherford Avenue at BSG for the Reduced River-Tunnel Alternative. In addition, for the year 2010 only, CO levels deteriorate at Leverett Circle for Alternative 8.1D Mod 5, and at New Chardon/Stillman Place/North Washington Street for all three alternatives.

In summary, for the year 2001 all three alternatives result in beneficial effects when compared to Scheme Z, with no substantial difference among alternatives. For the year 2010 when the roadway system is closer to capacity, the Reduced River-Tunnel and the Non-River-Tunnel Alternatives still have beneficial

PEAK DAILY EMISSION BURDENS IN THE STUDY AREA FOR THE YEAR 2010
(tons per day)

Affected Zone	CO				VOC				NO _x				PM ₁₀			
	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel
Area North of Causeway Street																
highways and ramps	6.70	6.23	7.55	6.48	0.51	0.46	0.54	0.48	0.84	0.70	0.82	0.75	0.26	0.22	0.25	0.24
covered highways	1.08	1.81	1.54	1.70	0.09	0.15	0.12	0.13	0.16	0.27	0.18	0.21	0.04	0.06	0.04	0.05
local streets	5.56	5.13	5.10	5.15	0.37	0.34	0.34	0.35	0.39	0.35	0.35	0.35	0.88	0.77	0.77	0.77
Central Area																
highways and ramps	6.09	6.46	6.09	6.15	0.45	0.47	0.45	0.46	0.71	0.71	0.71	0.71	0.22	0.22	0.22	0.22
covered highways	3.74	3.99	4.00	3.99	0.29	0.31	0.31	0.31	0.50	0.53	0.53	0.52	0.11	0.12	0.12	0.12
local streets	15.80	14.78	15.04	15.09	1.04	0.98	0.99	1.00	0.78	0.75	0.76	0.76	1.74	1.68	1.69	1.70
I-93/I-90 Interchange																
highways and ramps	7.59	7.50	7.68	7.67	0.52	0.52	0.53	0.53	0.72	0.72	0.72	0.72	0.22	0.22	0.23	0.22
covered highways	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
local streets	10.38	10.10	10.12	10.15	0.73	0.71	0.71	0.71	0.65	0.64	0.64	0.65	1.11	1.10	1.10	1.10
South Boston																
highways and ramps	0.76	0.74	0.74	0.73	0.05	0.05	0.05	0.05	0.07	0.07	0.07	0.07	0.02	0.02	0.02	0.02
covered highways	1.86	1.77	1.78	1.78	0.16	0.16	0.16	0.16	0.32	0.31	0.31	0.31	0.07	0.07	0.07	0.07
local streets	10.82	10.81	10.70	10.81	0.76	0.76	0.75	0.76	0.68	0.68	0.68	0.68	1.17	1.15	1.16	1.16
East Boston																
highways	2.84	2.77	2.90	2.95	0.22	0.22	0.22	0.23	0.37	0.37	0.37	0.37	0.12	0.12	0.12	0.12
covered ramps	0.57	0.56	0.56	0.55	0.05	0.05	0.05	0.05	0.11	0.11	0.11	0.11	0.02	0.02	0.02	0.02
local streets	6.01	5.72	5.85	5.85	0.40	0.38	0.39	0.39	0.32	0.31	0.32	0.32	0.67	0.66	0.66	0.67
East Cambridge																
highways and ramps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
covered highways	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
local streets	15.74	15.26	15.64	15.59	1.07	1.03	1.06	1.06	0.78	0.77	0.77	0.77	1.51	1.50	1.50	1.49
local street subtotals	64.32	61.79	62.45	62.65	4.38	4.20	4.26	4.27	3.61	3.50	3.52	3.53	7.06	6.84	6.89	6.90
hwys./ramps/covered hwys. subtotal	31.23	31.83	32.84	32.02	2.36	2.38	2.44	2.39	3.80	3.79	3.82	3.78	1.09	1.08	1.09	1.08
Totals	95.55	93.62	95.29	94.67	6.74	6.59	6.69	6.66	7.41	7.29	7.35	7.31	8.16	7.92	7.98	7.98



FIGURE

4.26

Location Of Mobile Sources Carbon Monoxide Modeling Sites Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



Table 4.21

ESTIMATED 1-HOUR WORST CASE CARBON MONOXIDE LEVELS
YEAR 2001 - MOBILE SOURCES
(ppm)

No. Location	Scheme Z	8.1D Mod 5	Non-River-Tunnel	Reduced River-Tunnel
1. Gilmore Bridge & O'Brien Highway	11.0	11.2	11.0	11.0
2. City Square	12.2	8.3	8.2	7.7
3. Leverett Circle	9.2	9.3	9.2	8.7
4. Causeway/Merrimac/Lomasney	12.8	11.3	12.3	10.8
5. Causeway & Haverhill Road	9.0	8.8	8.0	8.8
6. Causeway & Beverly Road	9.0	8.8	8.7	8.7
7. North Washington & Commercial (Keany Sq.)	13.0	12.3	12.7	12.7
8. New Sudbury & Congress Streets	9.5	8.8	9.8	8.8
9. New Chardon/Haverhill/North Washington	10.2	9.7	10.5	9.8
10. New Chardon/Stillman/North Washington	9.7	10.2	10.2	10.3
14. Congress & State Streets	6.5	6.7	6.5	6.5
15. State Street & Surface Road	9.5	9.2	9.2	9.2
34. Cambridge & Staniford Streets	12.0	11.5	11.7	11.7
40. Rutherford/C-L @ Bunker Hill College	9.2	9.8	9.7	9.5
41. Rutherford & Gilmore Bridge	8.8	8.7	8.7	8.5
42. Rutherford/BS & G	9.5	8.3	8.7	8.2
43. Lechmere Square	8.0	7.8	8.0	7.8
44. Nashua Street and Martha Road	10.8	10.3	10.3	10.2
45. Cambridge & New Chardon Streets	11.7	10.8	10.5	10.8
46. Cambridge & New Sudbury Streets	11.8	11.0	10.5	11.0
47. Charles Circle	9.2	8.8	9.3	9.2
48. Broadway & Third Street	5.8	5.8	5.8	5.8
49. Sullivan Square	8.5	8.3	8.2	8.2

- Notes:
1. Analysis sites numbered 1 to 34 coincide with numbering utilized in the 1990 FSEIS/R, locations 40 - 49 are new sites.
 2. CO 1-hour AAQS is 35 ppm.
 3. Values include 1-hour CO background level of 4.0 ppm.

Source: Bechtel/Parsons Brinckerhoff

Table 4.22

ESTIMATED 8-HOUR WORST CASE CARBON MONOXIDE LEVELS
YEAR 2001 - MOBILE SOURCES
(ppm)

No. Location	Scheme Z	8.1D Mod. 5	Non-River-Tunnel	Reduced River-Tunnel
1. Gilmore Bridge & O'Brien Highway	6.6	6.7	6.6	6.6
2. City Square	7.3	5.0	4.9	4.6
3. Leverett Circle	5.5	5.6	5.5	5.2
4. Causeway/Merrimac/Lomasney	7.7	6.8	7.4	6.5
5. Causeway & Haverhill Road	5.4	5.3	4.8	5.3
6. Causeway & Beverly Road	5.4	5.3	5.2	5.2
7. North Washington & Commercial (Keany Sq.)	7.8	7.4	7.6	7.6
8. Sudbury & Congress Streets	5.7	5.3	5.9	5.3
9. New Chardon/Haverhill/North Washington	6.1	5.8	6.3	5.9
10. New Chardon/Stillman/North Washington	5.8	6.1	6.1	6.2
14. Congress & State Streets	3.9	4.0	3.9	3.9
15. State Street & Surface Road	5.7	5.5	5.5	5.5
34. Cambridge & Staniford Streets	7.2	6.9	7.0	7.0
40. Rutherford/C-L @ Bunker Hill College	5.5	5.9	5.8	5.7
41. Rutherford & Gilmore Bridge	5.3	5.2	5.2	5.1
42. Rutherford/BS & G	5.7	5.0	5.2	4.9
43. Lechmere Square	4.8	4.7	4.8	4.7
44. Nashua Street and Martha Road	6.5	6.2	6.2	6.1
45. Cambridge & New Chardon Streets	7.0	6.5	6.3	6.5
46. Cambridge & New Sudbury Streets	7.1	6.6	6.3	6.6
47. Charles Circle	5.5	5.3	5.6	5.5
48. Broadway & Third Street	3.5	3.5	3.5	3.5
49. Sullivan Square	5.1	5.0	4.9	4.9

Note: 1. Analysis sites numbered 1 to 34 coincide with numbering utilized in the 1990 FSEIS/R, locations 40 - 49 are new sites.
2. CO 8-hour AAQS is 9 ppm.
3. Values include 8-hour CO background level of 2.4 ppm.

Source: Bechtel/Parsons Brinckerhoff

Table 4.23

ESTIMATED 1-HOUR WORST CASE CARBON MONOXIDE LEVELS
YEAR 2010 - MOBILE SOURCES
(ppm)

No. Location	Scheme Z	8.1D Mod. 5	Non-River- Tunnel	Reduced River- Tunnel
1. Gilmore Bridge & O'Brien Highway	12.2	12.6	12.6	12.4
2. City Square	12.1	9.1	8.7	8.7
3. Leverett Circle	10.4	11.7	9.7	9.2
4. Causeway/Merrimac/Lomasney	12.9	12.4	12.1	12.2
5. Causeway & Haverhill Road	9.7	9.9	9.7	9.7
6. Causeway & Beverly Road	9.7	9.7	9.2	9.2
7. North Washington & Commercial (Keany Sq.)	13.6	12.9	13.1	12.9
8. Sudbury & Congress Streets	10.1	9.9	9.7	9.7
9. New Chardon/Haverhill/North Washington	10.6	10.1	10.6	9.9
10. New Chardon/Stillman/North Washington	10.1	11.1	11.1	11.4
14. Congress & State Streets	8.4	8.6	8.4	8.1
15. State Street & Surface Road	9.7	9.7	9.7	9.7
34. Cambridge & Staniford Streets	12.2	12.1	11.7	11.9
40. Rutherford/C-L @ Bunker Hill College	9.7	10.2	9.7	9.7
41. Rutherford & Gilmore Bridge	9.9	9.2	9.2	9.2
42. Rutherford/BS & G	10.1	9.6	9.6	8.9
43. Lechmere Square	8.4	8.2	8.2	8.4
44. Nashua Street and Martha Road	11.9	11.7	10.6	11.9
45. Cambridge & New Chardon Streets	11.9	11.1	10.9	11.1
46. Cambridge & New Sudbury Streets	12.2	11.2	11.1	11.2
47. Charles Circle	9.9	9.9	9.9	9.9
48. Broadway & Third Street	6.4	6.2	6.4	6.4
49. Sullivan Square	8.9	8.2	8.4	8.4

Note:

1. Analysis sites numbered 1 to 34 coincide with numbering utilized in the 1990 FSEIS/R, locations 40 - 49 are new sites.
2. CO 1-hour AAQS is 35 ppm.
3. Values include 1-hour CO background level of 4.4 ppm.

Source: Bechtel/Parsons Brinckerhoff

Table 4.24

**ESTIMATED 8-HOUR WORST CASE CARBON MONOXIDE LEVELS
YEAR 2010 - MOBILE SOURCES
(ppm)**

No. Location	Scheme Z	8.1D Mod. 5	Non-River-Tunnel	Reduced River-Tunnel
1. Gilmore Bridge & O'Brien Highway	7.3	7.5	7.5	7.4
2. City Square	7.2	5.4	5.2	5.2
3. Leverett Circle	6.2	7.0	5.8	5.5
4. Causeway/Merrimac/Lomasney	7.7	7.4	7.2	7.3
5. Causeway & Haverhill Road	5.8	5.9	5.8	5.8
6. Causeway & Beverly Road	5.8	5.8	5.5	5.5
7. North Washington & Commercial (Keany Sq.)	8.1	7.7	7.8	7.7
8. Sudbury & Congress Streets	6.0	5.9	5.8	5.8
9. New Chardon/Haverhill/North Washington	6.3	6.0	6.3	5.9
10. New Chardon/Stillman/North Washington	6.0	6.6	6.6	6.8
14. Congress & State Streets	5.0	5.1	5.0	4.8
15. State Street & Surface Road	5.8	5.8	5.8	5.8
34. Cambridge & Staniford Streets	7.3	7.2	7.0	7.1
40. Rutherford/C-L @ Bunker Hill College	5.8	6.1	5.8	5.8
41. Rutherford & Gilmore Bridge	5.9	5.5	5.5	5.5
42. Rutherford/BS & G	6.0	5.7	5.7	5.3
43. Lechmere Square	5.0	4.9	4.9	5.0
44. Nashua Street and Martha Road	7.1	7.0	6.3	7.1
45. Cambridge & New Chardon Streets	7.1	6.6	6.5	6.6
46. Cambridge & New Sudbury Streets	7.3	6.7	6.6	6.7
47. Charles Circle	5.9	5.9	5.9	5.9
48. Broadway & Third Street	3.8	3.7	3.8	3.8
49. Sullivan Square	5.3	4.9	5.0	5.0

- Note:
1. Analysis sites numbered 1 to 34 coincide with numbering utilized in the 1990 FSEIS/R, locations 40 - 49 are new sites.
 2. CO 8-hour AAQS is 9 ppm.
 3. Values include 8-hour CO background level of 2.6 ppm.

Source: Bechtel/Parsons Brinckerhoff

effects compared to Scheme Z, while Alternative 8.1D Mod 5 results in very similar CO levels to those with Scheme Z.

4.3.3(d) Ventilation Building Emissions Impacts

Analytical modeling was performed to evaluate the CO, NO₂, and PM₁₀ impacts resulting from the ventilation building emissions associated with the three new design alternatives. Each alternative requires one ventilation building on the south bank of the river (designated for the purpose of this report ventilation building 8). The ventilation building 8 for Alternative 8.1D Mod 5 is larger than the ventilation building 8 for the other two alternatives. The Reduced River-Tunnel Alternative requires an additional ventilation building on the north bank of the river (designated for the purpose of this report ventilation building 9). The locations of ventilation buildings 8 and 9 are illustrated in Figure 4.27.

A detailed description of the technical approach, assumptions, model input, and the methodology used for compliance demonstration are presented in Section 7 of the Air Quality Appendix.

In the absence of advanced level of design information concerning future structures surrounding the proposed ventilation buildings, reasonable assumptions about building dimensions and systems (air intakes and operable windows) were taken into account in this air quality impact assessment. Depending on the level of information available, additional air quality studies including physical modeling will be undertaken to facilitate the final design of the ventilation buildings and to ensure that the operation of the ventilation buildings will comply with the applicable air quality standards and guidelines. A physical simulation of exhaust dispersion, performed in a boundary-layer wind tunnel, has an advantage over analytical modeling in that it accounts for the complex effect of building geometries on the local wind flow and dispersion.

Results from the analytical modeling follow.

The Good Engineering Practice Ventilation Stack Height. Numerous tall and massive structures surround the selected ventilation building sites. In general, it is good engineering practice (GEP) to design an exhaust stack to a height that avoids aerodynamic downwash of the exhaust plume caused by adjacent or nearby buildings. This height, referred to as the GEP stack or vent height, was calculated for each of the alternatives. The methodology used for these calculations is in accordance with the guidance contained in *Guideline for Determination of Good Engineering Practice Stack Height, Technical Support Document for the Stack Height Regulations*, EPA (1985) (see Section 7.2.1 of the Air Quality Appendix).

The GEP stack height was calculated to be 1,135 feet (346 meters) for all three new design alternatives. Stack height this tall is impractical to build. The discussion below summarizes the results of an evaluation used to refine the stack height to a more practical level.

Ventilation Stack Height Determination. The exhaust stack height(s) for each of the new design alternatives are the lowest stack height(s) for which no violation of an applicable AAQS would be expected to occur. This section briefly describes the procedures employed to determine these lowest possible stack heights.

Cavity Analysis: A cavity analysis was performed using the SCREEN model (EPA, 1988) to evaluate concentrations at receptors close to the ventilation building(s) for stack heights below GEP. A cavity nominally extends three building heights downwind of a structure. This analysis was selected as the first iteration of the stack height determination procedure because ground-level impacts within the cavity

region are often much greater (and therefore more limiting in terms of facility design) than impacts beyond it.

Using a trial-and-error approach, the lowest possible stack height(s) that produced concentration estimates in compliance with the 1-hour NO_2 guideline value were determined for each alternative. A stack height of 330 feet was required for emissions from ventilation building 8 for both Alternative 8.1D Mod 5 and the Non-River-Tunnel Alternative. Stack heights required for the Reduced River-Tunnel Alternative were determined to be 320 feet for ventilation building 8 and 105 feet for ventilation building 9. These heights are based on a full-build condition of the potential future development in the ventilation building area. The maximum zoning height for the future potential development in the area of ventilation building 8 is 300 feet. There are no future facilities planned to be built in the area near ventilation building 9.

Ventilation emission rates for each new design alternative are given in Table 4.25. Ventilation building design parameters and the resulting stack heights are given in Table 4.26. The methodology employed to make this determination, as well as the results obtained, are discussed in detail in Section 7.2.2 of the Air Quality Appendix.

Dispersion Analysis: Once the stack height was established, pollutant impacts beyond the cavity were estimated. Consistent with the 1991 FSEIS/R, the EPA-approved Industrial Source Complex Short-Term (ISCST2) Dispersion Model was used to calculate pollutant concentrations at distances beyond the cavity region. The ISCST2 model has been revised by EPA since the 1991 FSEIS/R. This most recent version (EPA-450/4-92-008, September 1992) was used in this study.

Pollutant concentrations resulting from ventilation building emissions of the three new design alternatives were calculated using a comprehensive receptor network. This network consists of a uniform polar receptor grid extended 2 kilometers downwind of ventilation building 8 (720 receptors) and a set of discrete receptors. These discrete receptors were placed at sensitive locations such as air intakes or operable windows of nearby buildings, residences, and hospitals.

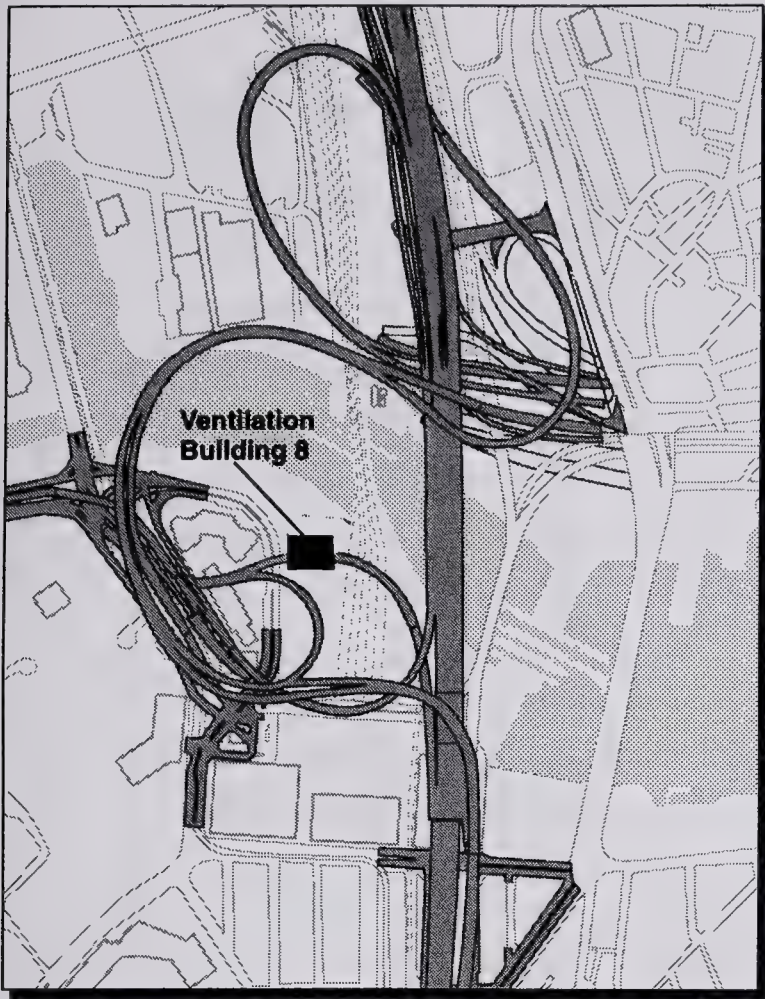
The most recent 5 years of readily available hourly surface meteorological data (1985 to 1989), collected at Boston Logan Airport, a National Weather Service (NWS) station, was used in the modeling analyses. Concurrent daily mixing height values were obtained from upper-air data collected at the Portland, Maine, NWS station (B/PB, 1993).

Most of the NO_x emitted by motor vehicles is in the form of nitric oxide (NO). This NO is then converted to NO_2 via reactions in the atmosphere with other oxidants, mainly O_3 . The Ozone Limiting Method (OLM) was used to account for the conversion of NO into NO_2 , and the maximum overall conversion rate is 81 percent. This maximum conversion methodology was developed and approved in the 1991 FSEIS.

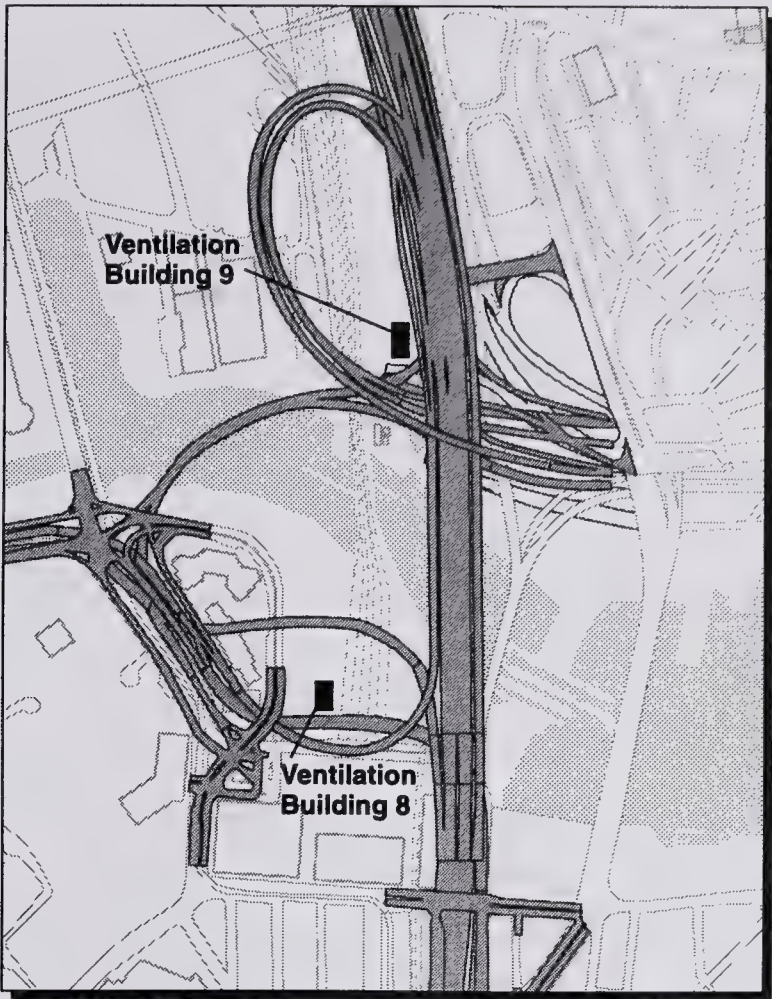
The methodology used to perform this dispersion analysis and the results of the analysis are discussed in detail in Section 7.2.3 and Section 7.3, respectively, of the Air Quality Appendix.

Results of the dispersion analysis confirm that emissions from the stack heights determined in the cavity analysis produce ambient air quality levels in compliance with applicable ambient air quality standards and guidelines.

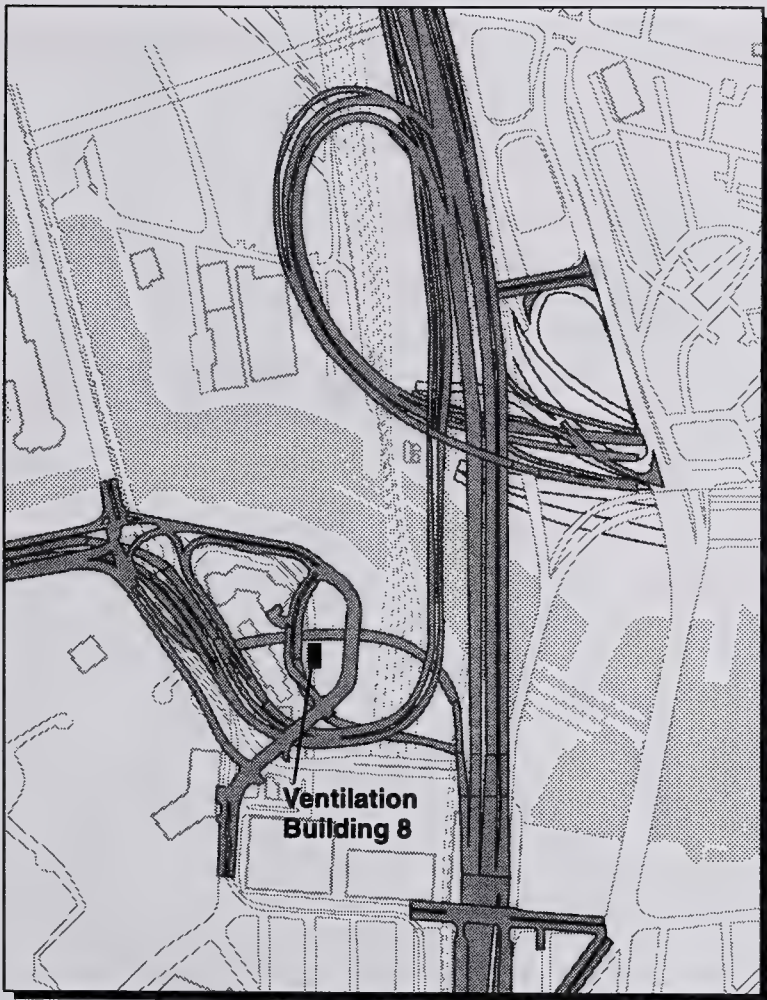
Model Results. Maximum hourly CO and NO_2 concentrations for all the alternatives are presented in Table 4.27. The modeling results indicate that the maximum calculated concentrations for all analyzed cases occurred in the immediate vicinity of the ventilation site, within the cavity produced by the



Alternative 8.1D Mod 5



Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

FIGURE

4.27

**Proposed Locations For
Ventilation Buildings**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



Table 4.25

VENTILATION BUILDING EMISSION RATES (g/s)

Bldg. No.	Alternative	CO 1-hour ¹	CO 8-hour ²	NO _x 1-hour	NO _x 8-hour	PM ₁₀ 8-hour
Year 2001						
1		5.738	4.263	0.753	0.533	
3		18.514	13.763	2.348	1.860	
4		25.757	14.742	2.624	1.915	
5		7.303	3.989	0.921	0.600	
6		6.049	2.945	0.761	0.444	
7		10.758	5.592	1.385	0.775	
8	8.1D Mod 5	12.344	9.192	1.646	1.279	
8	Non-River-Tunnel	2.899	2.213	0.405	0.321	
8	Reduced River-Tunnel	2.784	2.139	0.398	0.310	
9	Reduced River-Tunnel	2.999	2.286	0.484	0.372	
Year 2010						
1		6.809	5.517	0.788	0.658	0.226
3		27.010	16.984	2.630	2.000	0.694
4		37.887	18.479	3.041	2.095	0.728
5		9.803	6.030	0.999	0.770	0.294
6		8.470	5.276	0.860	0.647	0.250
7		14.258	9.564	1.481	1.156	0.416
8	8.1D Mod 5	16.328	10.316	1.834	1.353	0.299
8	Non-River-Tunnel	3.386	2.583	0.438	0.348	0.077
8	Reduced-River-Tunnel	3.519	2.540	0.482	0.343	0.077
9	Reduced River-Tunnel	4.122	2.758	0.526	0.393	0.088

¹ Peak 1-hour emissions based on peak 1-hour traffic.² Peak 8-hour emissions based on peak 8-hour traffic.

Source: Bechtel/Parsons Brinckerhoff

Table 4.26

VENTILATION BUILDING DESIGN PARAMETERS

Bldg. No.	Alternative	Stack Height (m)	Exit Velocity (m/s)	Stack Effective Diameter (m)
8	8.1D Mod 5 (above ground)	100.6	7.62	6.86
8	Non-River-Tunnel (under ground)	100.6	7.62	5.22
8	Reduced River-Tunnel (under ground)	97.5	7.62	5.42
9	Reduced River-Tunnel (above ground)	32.0	7.62	5.32
1		41.1	8.13	10.07
3		73.2	8.13	13.08
4		38.1	8.13	13.70
5		38.9	8.13	12.38
6		27.7	8.13	8.64
7		32.7	8.13	13.20
Bldg. No.	Alternative	Width (m)	Length (m)	Height (m)
8	8.1D Mod 5	33.6	38.4	18.3
9	Reduced River-Tunnel	12.6	34.2	18.3

Note: Vent effluent temperature assumed as ambient.

Source: Bechtel/Parsons Brinckerhoff

ventilation building, or the adjacent future development complex. Selection of the Reduced River-Tunnel Alternative, for example, resulted in maximum ground-level impacts of $64 \mu\text{g}/\text{m}^3$ for NO_2 and 0.44 ppm for CO.

The highest 8-hour CO, 24-hour PM_{10} , and annual NO_2 and PM_{10} concentrations are presented in Table 4.28 for all analyzed alternatives.

Comparison Of Alternatives. As presented in the 1991 FSEIS/R, Scheme Z does not require any ventilation buildings because it has no tunnels north of Causeway Street. Therefore, the air quality impacts resulting from the ventilation building emissions for each of the design alternatives as reported in the last section can be viewed as incremental impacts relative to the Scheme Z design.

Incremental impacts for the three new design alternatives are reported in Tables 4.27 and 4.28. Significant impact levels, below which insignificant effects to public health are expected, are also given in these tables for comparison.

The results show that all three design alternatives are expected to result in insignificant incremental impacts for both the CO and PM_{10} pollutants. The maximum 1-hour NO_2 impacts for all three new design alternatives are above the DEP significant impact level ($32 \mu\text{g}/\text{m}^3$). The highest maximum impact, however, is only 20 percent of the DEP ambient hourly guideline value ($320 \mu\text{g}/\text{m}^3$).

As shown in Tables 4.27 and 4.28, higher pollutant impacts were predicted for the year 2010. The highest 1-hour CO concentration (0.44 ppm) is associated with the Reduced River-Tunnel Alternative while the highest 8-hour CO concentration (0.07 ppm) is associated with Alternative 8.1D Mod 5. Modeling results also indicate that 8.1D Mod 5 produces the highest 24-hour PM_{10} concentration ($1.4 \mu\text{g}/\text{m}^3$). The Reduced River-Tunnel Alternative results in higher annual impacts for both NO_2 and PM_{10} . Results from Tables 4.27 and 4.28 indicate that the differences in air quality impacts are small among the three alternatives.

In summary, Alternative 8.1D Mod 5 results in higher 8-hour CO and 24-hour PM_{10} air quality impacts. The Reduced River-Tunnel Alternative, however, yields the highest 1-hour impacts for both CO and NO_2 , and the highest annual impacts for both NO_2 and PM_{10} all pollutants. Differences in air quality impacts are small among the alternatives.

4.3.3(e) Combined Air Quality Impacts

As discussed in Section 4.3.3(a), Project emissions are those pollutants exhausted from motor vehicles travelling within the area affected by the Project. Air quality impacts from surface traffic have been analyzed in Section 4.3.3(c), Mobile Source Impacts. Vehicle emissions from traffic in the tunnel are released to the atmosphere through the ventilation building stacks. Results of the air quality impacts from tunnel traffic are presented in Section 4.3.3(d), Ventilation Building Emissions Impacts. This section addresses the combined impacts from both the surface and tunnel traffic emissions.

Combined Impacts From All Ventilation Buildings. The results reported in Section 4.3.3(d) conclude that air quality (CO, NO_2 , PM_{10}) emissions resulting solely from the operation of the proposed ventilation building 8 (and ventilation building 9 for the Reduced River-Tunnel Alternative) alone have minimal effects on the surrounding environment. In addition to the ventilation building(s) for the Charles River crossing, the entire Central Artery/Tunnel Project includes six other planned ventilation buildings (ventilation buildings 1, 3, 4, 5, 6, and 7). All are located at least 2,000 feet from the proposed ventilation buildings 8 and 9. Under certain meteorological conditions, it is possible for exhaust plumes from various ventilation buildings to merge, causing a combined air quality impact greater than that from

ventilation building 8 alone or ventilation building 8 and 9 combined. Therefore, the combined impact from all ventilation building emissions was also modeled for demonstration compliance. Total concentrations used in the demonstration include contributions from all the ventilation buildings as well as the background concentrations in the area. If these total concentrations are less than the corresponding applicable standards and DEP's 1-hour policy guideline value for NO₂, then the compliance demonstration is considered complete.

Ventilation building emission rates and building design parameters used for the model calculations are given in Tables 4.25 and 4.26. The same air quality model (ISCST2) as described in Section 4.3.3(d) was used to perform this evaluation.

The modeling results indicate that the maximum impact locations for all the ventilation buildings combined are the elevated receptors located on tall buildings near the Haymarket area. The contributions from ventilation buildings 8 and 9 are insignificant at these locations.

Maximum predicted concentrations of NO₂, CO, and PM₁₀ for all ventilation buildings are presented in Table 4.29. The required background CO concentrations were developed in Section 4.3.3(c). Background PM₁₀, NO₂, and O₃ concentrations used in this study were provided by DEP. A detailed description of the conversion of NO_x into NO₂ can be found in Section 7.2.3 of the Air Quality Appendix.

As shown in Table 4.29, the maximum combined CO, NO₂, and PM₁₀ impacts from all ventilation buildings, when added to their appropriate background concentrations, are well below their corresponding National and State AAQS. Higher impacts occurred for the year 2010 due to higher vehicle emission rates forecast for that year. The differences among the alternatives are minimal; however, impacts for the Non-River-Tunnel Alternative are slightly less than the other two alternatives.

Combined Mobile Sources And Ventilation Building Impacts. Mobile source impacts occur primarily adjacent to congested roadways under low wind speeds and stable atmospheric conditions. Peak ground-level impacts from vehicular exhausts passing through the ventilation buildings generally occur several hundred feet from the buildings under moderate to high wind conditions and unstable atmospheric conditions. In addition, it is unlikely that the location of maximum air quality impacts from these different source types would be identical.

Nevertheless, in order to conservatively estimate the potential combined impacts of these sources, peak ground-level 1-hour and 8-hour CO impacts from all proposed ventilation buildings in the entire Project were analyzed for the same 23 intersections evaluated in the mobile source analysis. The same meteorological conditions assumed to present the worst case dispersion scenario were also used. (A description of this analysis is provided in Section 8 of the Air Quality Appendix.)

The highest ground-level CO impacts from the ventilation buildings for any of the 23 intersections were 0.19 ppm for the 1-hour and 0.11 ppm for the 8-hour peak for Alternative 8.1D Mod 5. These levels are one to two orders of magnitude less than the estimated CO levels from the roadway traffic. When these values are combined with the peak 1-hour and 8-hour CO values predicted for the mobile source analysis (Tables 4.21 to 4.24), all total predicted values are still less than (in compliance with) the National and Massachusetts AAQS. Therefore, the combined impacts of the mobile source emissions on the roadway and ventilation building releases from tunnel traffic at any receptor location under any meteorological conditions would be less than (in compliance with) applicable AAQS. These results indicate that the highest combined estimated CO levels still occur at the intersection of North Washington and Commercial Streets (Keany Square) for Scheme Z for both years of analysis.

Table 4.27

**MAXIMUM PREDICTED ONE-HOUR NO₂ AND CO IMPACTS
BASED ON THE RESULTS OF ANALYTICAL MODELING**

	Alternative	NO ₂ (µg/m ³)		CO (ppm)	
		Within Cavity	Beyond Cavity	Within Cavity	Beyond Cavity
Project Year 2001	8.1D Mod 5	31.6	41.6	0.21	0.27
	Non-River-Tunnel	36.2	11.1	0.23	0.07
	Reduced River-Tunnel	59.2	26.7	0.32	0.15
Project Year 2010	8.1D Mod 5	35.2	46.4	0.28	0.36
	Non-River-Tunnel	39.1	12.0	0.27	0.08
	Reduced River-Tunnel	64.4	29.0	0.44	0.20
Significant impact level		32	32	1.75	1.75

Notes: One-hour NO₂ and CO values are based on the emission rate for the peak traffic hour.
A maximum conversion rate (100 percent) of NO_x into NO₂ was assumed.



**MAXIMUM PREDICTED NO₂, CO, AND PM₁₀ CONCENTRATION LEVELS
FOR ALL VENTILATION BUILDINGS BASED ON THE RESULTS OF ANALYTICAL MODELING**

Project Year	Alternative	NO ₂ (µg/m ³)		CO (ppm)		PM ₁₀ (µg/m ³)	
		1-hour ^a	Annual ^b	1-hour ^a	8-hour ^b	24-hour ^b	Annual ^b
2001							
	Background	variable	60.0	4.00	2.40	N/A	N/A
	8.1D Mod 5	260.0	62.3	5.93	2.70	N/A	N/A
	Non-River-Tunnel	260.0	62.1	5.81	2.66	N/A	N/A
2010	Reduced River-Tunnel	260.0	62.3	5.93	2.70	N/A	N/A
	Background	variable	60.0	4.40	2.60	96.0	38.0
	8.1D Mod 5	261.0	62.5	7.23	2.97	105.3	38.9
	Non-River-Tunnel	261.0	62.3	7.06	2.92	103.8	38.8
	Reduced River-Tunnel	261.0	62.5	7.23	2.97	105.3	38.9
	AAQS	N/A	100.0	35.0	9.0	150.0	50.0
	DEP Policy						
	Level	320.0	N/A	N/A	N/A	N/A	N/A

Notes: ^a 1-hour NO₂ and CO values are based on the emission rate for the peak traffic hour. For 1-hour NO₂ impacts, the conversion of NO_x to NO₂ was based on OLM.

^b 8-hour CO and annual NO₂ and PM₁₀ values are based on the emission rate for the peak 8-hour traffic period. For annual NO₂ impacts, 100 percent conversion of NO_x to NO₂ was assumed.

Source: Bechtel/Parsons Brinckerhoff

4.3.4 Summary Of Impacts

The results of this analysis indicate that, in general, the three new design alternatives have similar effects on local and regional air quality conditions when compared to Scheme Z.

The regional areawide emissions for each alternative are slightly smaller than the emissions estimated for Scheme Z, and they are not significantly different from one another.

The microscale analysis indicates that all three alternatives comply with the CO AAQS, and that the Reduced River-Tunnel and Non-River-Tunnel Alternatives have beneficial effects when compared to Scheme Z. In the case of Alternative 8.1D Mod 5 the overall levels are very similar to Scheme Z, with improvement at some intersections and deterioration at others.

The operation of the proposed ventilation buildings, as currently designed, produces minimal air quality effects to the surrounding environment and also results in air quality levels well within all applicable National and State AAQS and DEP Policy Guidelines for NO₂. When compared to each other, Alternative 8.1D Mod 5 has the least beneficial effects in terms of 8-hour and 24-hour impacts, and the Reduced River-Tunnel yields the highest 1-hour and annual impacts. Differences in air quality impacts are small among the alternatives.

4.3.5 Conformance With SIP And 1990 CAAA

The areawide (mesoscale) analysis shows decreases in emissions of CO, NO_x, and VOCs with any of the alternatives when compared to Scheme Z, and when compared to the 1990 base emission levels. The microscale analysis indicates that there will be no violations of the ambient air quality standards for the years 2001 and 2010 for Scheme Z or any of the new design alternatives. In addition, CO concentrations in 2010 are estimated to become lower (improve) at 12 to 14 locations with the alternatives compared to conditions in the year 2010 with Scheme Z. Also, no violations of any air quality standards are predicted as a result of pollutants released from any proposed ventilation building.

This Project is located in an air quality nonattainment area which has transportation control measures in the Massachusetts SIP, which has been approved by EPA. FHWA has determined that both the transportation plan and the transportation improvement program conform to the SIP, and that this Project is included in the transportation improvement program for the area. In addition, the Commonwealth of Massachusetts has adopted Transportation Project Guidelines for reviewing highway projects. If the Project meets all the criteria, it is considered to be consistent with the SIP. This analysis confirms that the three new design alternatives conform with the SIP, and with the requirements of the 1990 CAAA.

4.4 Noise And Vibration

This section describes the current noise and vibration levels in the Area North of Causeway Street and presents the noise and vibration impacts of the four designs. For this DSEIS/R, ambient noise was monitored in spring 1993 obtained at the 15 sites described in the 1991 FSEIS/R, and at eight additional noise-sensitive sites. Future noise levels for all three alternatives at all of the 23 noise receptor sites were predicted using FHWA STAMINA 2.0 traffic noise model. Predicted noise levels are compared with existing noise levels; with year 2010 Scheme Z (FSEIS/R Proposed Action) noise levels; and with the FHWA criteria for the applicable land use category.

Existing ground vibration levels were determined at representative sensitive structures. Future vibration levels for the Scheme Z and the three alternatives were projected based on future traffic conditions.

Where estimated future noise and vibration impacts are likely to occur, mitigation measures are proposed. Stationary noise sources for proposed ventilation buildings have been assessed for potential impacts as well. These buildings will be designed and built to be consistent with the Boston noise ordinance and Massachusetts DEP Regulations.

4.4.1 Noise

4.4.1(a) Affected Environment

The basic unit employed to describe existing and future noise levels in the affected area is the A-weighted decibel (dBA). The dBA provides a measure of the noisiness of sound as subjectively heard by humans. Detailed information on the dBA scale, the methodology used for obtaining existing and future noise levels in dBA, and the selection of criteria to assess future noise impacts is contained in the 1991 FSEIS/R and in its Noise and Vibration Appendix.

Since noise fluctuates from moment to moment, it is common practice to average time-varying noise levels over a specified period of time into a single number called the equivalent noise level (Leq). Many surveys show that the descriptor Leq (1 hour), measured in dBA, correlates well with subjective human response to noise, and properly predicts annoyance due to changes in noise levels.

Noise sensitive land uses in the area include residences, hospitals, a jail, one educational institution, and waterfront recreation areas. Existing noise levels (generally ranging from Leq 62 to 73 dBA) at these locations are generally dominated by noise generated by motor vehicles on nearby major roads and local streets. Noise monitoring sites were selected to provide uniform coverage of the Project area, even if not affected by some of the alternatives, and include all land uses, including future residential land uses.

Ambient noise measurements were made during April and May 1993 at the 23 selected sites during peak morning (7:00 AM to 10:00 AM) and peak afternoon (4:00 PM to 7:00 PM) traffic hours. Leq (1 hour) noise levels recorded at these 23 sites during those time periods are provided in Table 4.30.

Results of the noise measurement program indicate hourly morning Leqs ranging from 61 dBA to 73 dBA and hourly afternoon Leqs ranging from 62 dBA to 73 dBA. Such levels are typical of a daytime urban environment; these measurements exclude noise from aircraft sources.

4.4.1(b) Impacts

Traffic noise impacts of each of the three alternatives were assessed at each of the 23 receptor sites by comparing the predicted noise levels of each alternative with existing noise levels, with year 2010 levels reported for Scheme Z in the 1991 FSEIS/R, and with the FHWA noise criteria for the applicable land use category. The impact assessment using FHWA Noise Abatement Criteria (NAC) follows the procedure outlined in 23 CFR 772. All of the noise receptor sites have been renumbered; for purposes of comparison old site numbers reported in the 1991 FSEIS/R are also shown alongside the new site numbers, to provide a sequential list of sites in the area (see Figure 4.28 for the locations of the sites and Tables 4.30 to 4.35 for the data).

Comparison Of Existing Noise Levels. For impact assessment based on comparing future Project levels with existing levels, the following impact classifications are used:

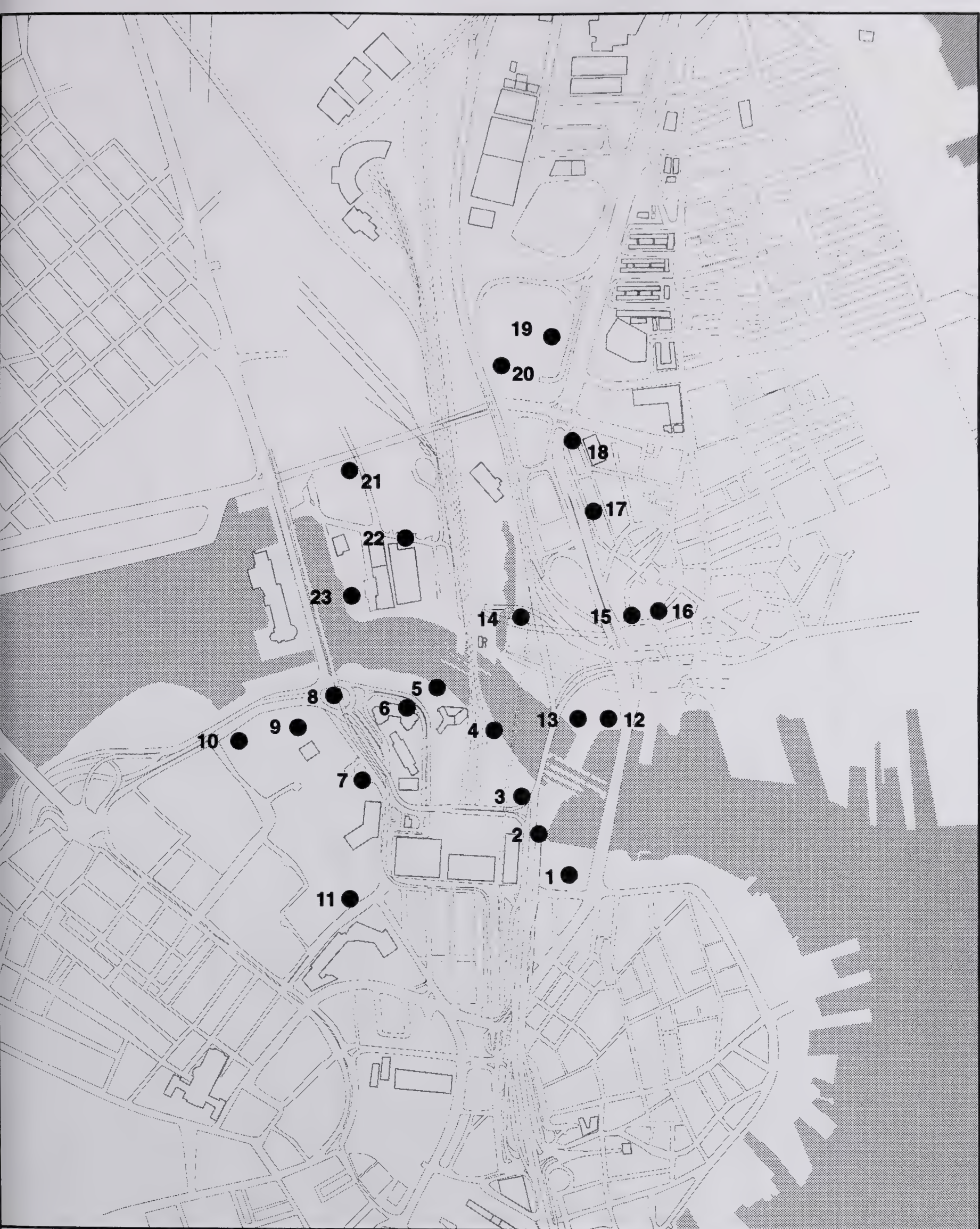


FIGURE
4.28
Noise Monitoring And
Prediction Sites
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET

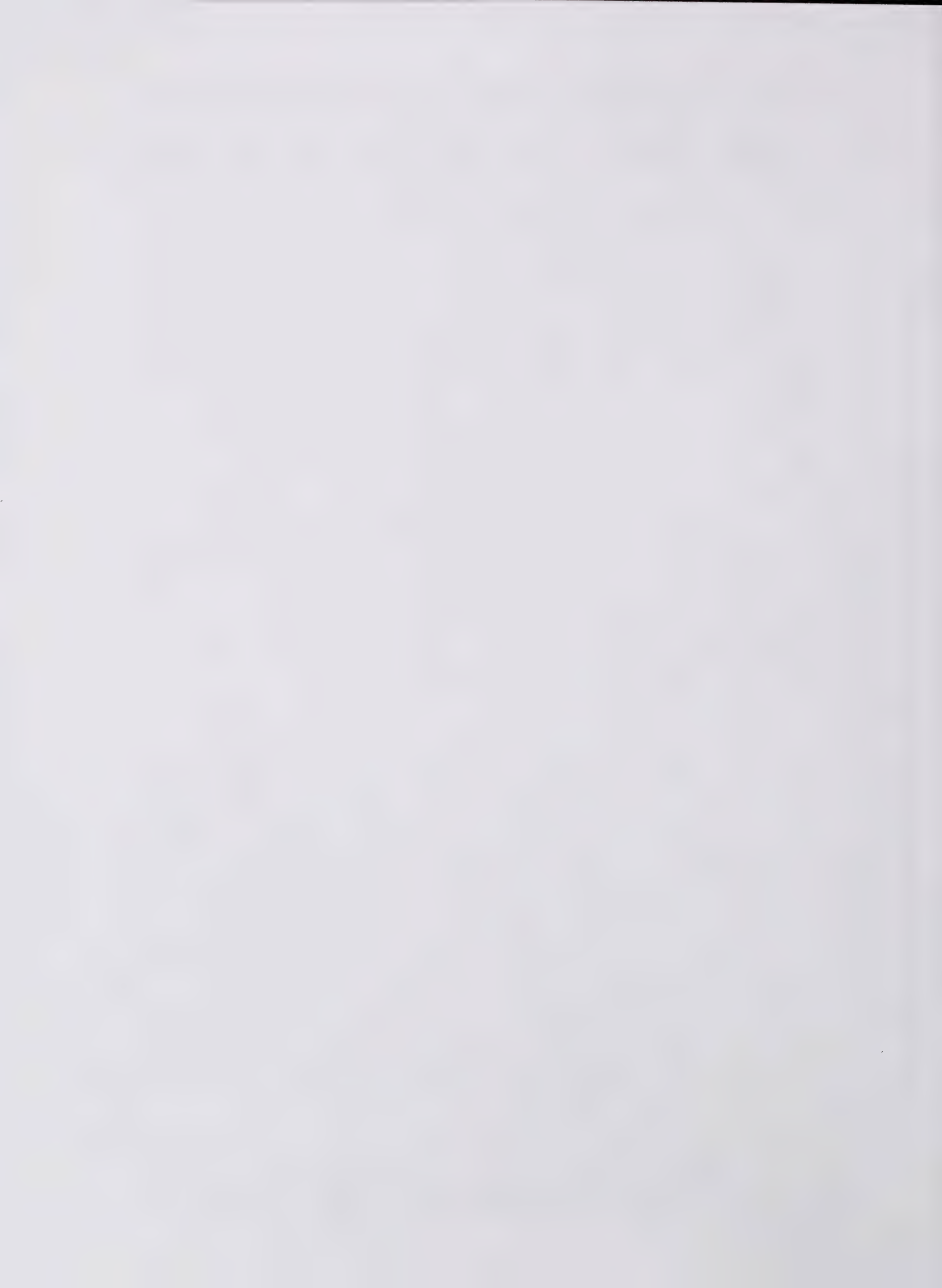




COMPARISON OF PREDICTED NOISE LEVELS IN 2010 WITH 1993 EXISTING LEVELS FOR ALTERNATIVE 8.1D Mod 5

Site No.	Site Description	In L eq (1 hour) dBA						Noise Abatement to Be Considered
		Existing		2010		Change Over Existing		
		AM	PM	AM	PM	AM	PM	
1 (27)	Charles River Building	68	67	65	68	-3	1	No
2 (28)	Paul Revere Landing Park South	69	69	67	68	-2	-1	No
3 (42)	south bank near Charles River dam	71	68	75	75	4	7	Yes
4 (40)	walkways adjoining MBTA commuter railroad bridge	68	69	72	72	4	3	No
5 (43)	Spaulding Rehab. Hospital-riverside benches	62	65	67	67	5	2	No
6	Suffolk County Jail	67	66	72	71	5	5	No
7	residential building at Amy Court and Martha Road	69	69	70	69	1	0	No
8 (29A)	Leverett Circle at pedestrian walkway	73	70	74	74	1	4	No
9 (29B)	residential apt. building near outdoor swimming pool	64	63	62	61	-2	-2	No
10	residential area across from Storrow Drive	70	68	76	73	6	5	Yes
11	residential apt. building on Stafford St.	67	67	71	71	4	4	No
12 (18)	Paul Revere Landing Park North	69	65	68	69	-1	4	No
13 (41)	north bank near Charles River dam	67	70	71	73	4	3	No
14 (44)	site of proposed pedestrian overpass near railroad tracks	66	67	64	66	-2	-1	No
15 (17)	Edward Everett House on Harvard St.	66	64	71	74	5	10	Yes
16 (45)	residential buildings on Main St. near court house	63	63	68	68	5	5	No
17 (46)	residential area along New Rutherford Avenue	73	71	73	75	0	4	No
18	residential area adjacent to New Rutherford Avenue	71	70	72	72	1	2	No
19	Bunker Hill Community College - area along New Rutherford Avenue	72	73	74	73	2	0	No
20 (47)	Bunker Hill Community College - rear entrance adjacent to train station	70	69	72	74	2	5	No
21	industrial park - site of proposed residential development	70	72	72	73	2	1	No
22	industrial park - site of proposed residential development	69	68	73	73	4	5	No
23 (39)	North Point - near proposed residential development area	61	62	67	68	6	6	Yes

() denotes site numbers in 1991 FSEIS/R
Source: Bechtel/Parsons Brinckerhoff



**COMPARISON OF PREDICTED NOISE LEVELS IN 2010 WITH 1993 EXISTING LEVELS
REDUCED RIVER-TUNNEL ALTERNATIVE**

Site No.	Site Description	In L eq (1 Hour) dBA							Noise Abatement Abatement to Be Considered
		Existing			2010		Change Over Existing		
		AM	PM	PM	AM	PM	AM	PM	
1 (27)	Charles River Building	68	67	68	69	0	2	No	
2 (28)	Paul Revere Landing Park South	69	69	69	70	0	1	No	
3 (42)	south bank near Charles River dam	71	68	76	75	5	7	Yes	
4 (40)	walkways adjoining MBTA commuter railroad bridge	68	69	71	70	3	1	No	
5 (43)	Spaulding Rehab. Hospital-riverside benches	62	65	66	66	4	1	No	
6	Suffolk County Jail	67	66	71	71	4	5	No	
7	residential building at Amy Court and Martha Road	69	69	70	69	1	0	No	
8 (29A)	Leverett Circle pedestrian walkway	73	70	75	74	2	4	No	
9 (29B)	residential apt. building near outdoor swimming pool	64	63	60	60	-4	-3	No	
10	residential area across from Storrow Drive	70	68	72	72	2	4	No	
11	residential apt. building on Stafford St.	67	67	72	72	5	5	No	
12 (18)	Paul Revere Landing Park North	69	65	67	68	-2	3	No	
13 (41)	north bank near Charles River dam	67	70	71	70	4	0	No	
14 (44)	site of proposed pedestrian overpass near railroad tracks	66	67	65	66	-1	-1	No	
15 (17)	Edward Everett House on Harvard St.	66	64	71	74	5	10	Yes	
16 (45)	residential buildings on Main St. near court house	63	63	68	69	5	6	Yes	
17 (46)	residential area along New Rutherford Avenue	73	71	73	75	0	4	No	
18	residential area adjacent to New Rutherford Avenue	71	70	72	72	1	2	No	
19	Bunker Hill Community College - area along New Rutherford Avenue	72	73	74	74	2	1	No	
20 (47)	Bunker Hill Community College - rear entrance adjacent to train station	70	69	70	73	0	4	No	
21	Industrial Park - site of proposed residential development	70	72	72	70	2	-2	No	
22	Industrial Park - site of proposed residential development	69	68	73	74	4	6	Yes	
23 (39)	North Point - near proposed residential development area	61	62	67	68	6	6	Yes	

() denotes site numbers in 1991 FSEIS/R
Source: Bechtel/Parsons Brinckerhoff

Table 4.32

COMPARISON OF PREDICTED NOISE LEVELS IN 2010 WITH 1993 EXISTING LEVELS FOR THE NON-RIVER-TUNNEL ALTERNATIVE

Site No.	Site Description	In L eq (1 hour) dBA						Noise Abatement to Be Considered
		Existing		2010		Change Over Existing		
		AM	PM	AM	PM	AM	PM	
1 (27)	Charles River Building	68	67	65	69	-3	2	No
2 (28)	Paul Revere Landing Park South	69	69	68	69	-1	0	No
3 (42)	south bank near Charles River dam	71	68	78	76	7	8	Yes
4 (40)	walkways adjoining MBTA commuter railroad bridge	68	69	73	72	5	3	No
5 (43)	Spaulding Rehab. Hospital-riverside benches	62	65	68	68	6	3	Yes
6	Suffolk County Jail	67	66	70	71	3	5	No
7	residential building at Amy Court and Martha Road	69	69	72	70	3	1	No
8 (29A)	Leverett Circle pedestrian walkway	73	70	74	76	1	6	Yes
9 (29B)	residential apt. building near outdoor swimming pool	64	63	61	60	-3	-3	No
10	residential area across from Storrow Drive	70	68	72	71	2	3	No
11	residential apt. building on Stafford St.	67	67	72	72	5	5	No
12 (18)	Paul Revere Landing Park North	69	65	67	69	-2	4	No
13 (41)	north bank near Charles River dam	67	70	72	72	5	2	No
14 (44)	site of proposed pedestrian overpass near railroad tracks	66	67	65	67	-1	0	No
15 (17)	Edward Everett House on Harvard St.	66	64	71	73	5	9	Yes
16 (45)	residential buildings on Main St. near court house	63	63	66	66	3	3	No
17 (46)	residential area along New Rutherford Avenue	73	71	73	74	0	3	No
18	residential area adjacent to New Rutherford Avenue	71	70	73	72	2	2	No
19	Bunker Hill Community College - area along New Rutherford Avenue	72	73	76	75	4	2	No
20 (47)	Bunker Hill Community College - rear entrance adjacent to train station	70	69	69	72	-1	3	No
21	Industrial Park - site of proposed residential development	70	72	73	73	3	1	No
22	Industrial Park - site of proposed residential development	69	68	72	74	3	6	Yes
23 (39)	North Point - near proposed residential development area	61	62	68	68	7	6	Yes

() denotes site numbers in 1991 FSEIS/R
Source: Bechtel/Parsons Brinckerhoff

Table 4.33

**PREDICTED NOISE LEVELS IN 2010
SCHEME Z AND ALTERNATIVE 8.1D Mod 5¹**

Site No.	Site Description	Existing (1993)		Scheme Z		Alternative 8.1D Mod 5		Mod 5 Over Scheme Z		Mod 5 Over NAC ²		Noise Abatement to Be Considered
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
1 (27) ³	Charles River Building	68	67	66	68	65	68	-1	0	-1	2	Yes
2 (28)	Paul Revere Landing Park South	69	69	68	70	67	68	-1	-2	1	2	Yes
3 (42)	south bank near Charles River dam	71	68	76	77	75	75	-1	-2	9	9	Yes
4 (40)	walkways adjoining MBTA commuter railroad bridge	68	69	76	76	72	72	-4	-4	6	6	Yes
5 (43)	Spaulding Rehab. Hospital-riverside benches	62	65	69	69	67	67	-2	-2	1	1	Yes
6	Suffolk County Sheriff's Department jail	67	66	72	71	72	71	0	0	6	5	Yes
7	residential building at Amy Court and Martha Road	69	69	72	71	70	69	-2	-2	4	3	Yes
8 (29A)	Leverett Circle pedestrian walkway	73	70	72	72	74	74	2	2	8	8	Yes
9 (29B)	residential apt. building near outdoor swimming pool	64	63	61	61	62	61	1	0	-4	-5	No
10	residential area across from Storow Drive	70	68	74	72	76	73	2	1	10	7	Yes
11	residential apt. building on Stafford St.	67	67	71	71	71	71	0	0	5	5	Yes
12 (18)	Paul Revere Landing Park North	69	65	68	69	68	69	0	0	2	3	Yes
13 (41)	north bank near Charles River dam	67	70	73	75	71	73	-2	-2	5	7	Yes
14 (44)	site of proposed pedestrian overpass near railroad tracks	66	67	72	73	64	66	-8	-7	-2	0	Yes
15 (17)	Edward Everett House on Harvard St.	66	64	73	76	71	74	-2	-2	5	8	Yes
16 (45)	residential buildings on Main St. near court house	63	63	65	66	68	68	3	2	2	2	Yes
17 (46)	residential area along Rutherford Avenue	73	71	75	75	73	75	-2	0	7	9	Yes
18	residential area adjacent to Rutherford Avenue	71	70	74	73	72	72	-2	-1	6	6	Yes
19	Bunker Hill Community College - area along Rutherford Avenue	72	73	75	73	74	73	-1	0	8	7	Yes
20 (47)	Bunker Hill Community College - rear entrance adjacent to train station	70	69	71	72	72	74	1	2	6	8	Yes
21	Industrial Park - site of proposed residential development	70	72	73	74	72	73	-1	-1	6	7	Yes
22	Industrial Park - site of proposed residential development	69	68	76	76	73	73	-3	-3	7	7	Yes
23 (39)	North Point - near proposed residential development area	61	62	68	69	67	68	-1	-1	1	2	Yes

Source: Bechtel/Parsons Brinckerhoff

¹ in L eq (1 hour) dBA² FHWA NAC³ Numbers in parentheses denote site numbers in the 1991 FSEIS/R

PREDICTED NOISE LEVELS IN 2010 SCHEME Z AND REDUCED RIVER-TUNNEL ALTERNATIVE¹

Site No.	Site Description	Existing (1993)		Scheme Z		Reduced River-Tunnel		Reduced River-Tunnel Over Scheme Z		Reduced River-Tunnel Alternative Over NAC ²		Noise Abatement to Be Considered
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
1 (27) ³	Charles River Building	68	67	66	68	68	69	2	1	2	3	Yes
2 (28)	Paul Revere Landing Park South	69	69	68	70	69	70	1	0	3	4	Yes
3 (42)	south bank near Charles River dam	71	68	76	77	76	75	0	-2	10	9	Yes
4 (40)	walkways adjoining MBTA commuter railroad bridge	68	69	76	76	71	70	-5	-6	5	4	Yes
5 (43)	Spaulding Rehab. Hospital-riverside benches	62	65	69	69	66	66	-3	-3	0	0	Yes
6	Suffolk County Sheriff's Department jail	67	66	72	71	71	71	-1	0	5	5	Yes
7	residential building at Amy Court and Martha Road	69	69	72	71	70	69	-2	-2	4	3	Yes
8 (29A)	Leverett Circle pedestrian walkway	73	70	72	72	75	74	3	2	9	8	Yes
9 (29B)	residential apt. building near outdoor swimming pool	64	63	61	61	60	60	-1	-1	-6	-6	No
10	residential area across from Storrow Drive	70	68	74	72	72	72	-2	0	6	6	Yes
11	residential apt. building on Stafford St.	67	67	71	71	72	72	1	1	6	6	Yes
12 (18)	Paul Revere Landing Park North	69	65	68	69	67	68	-1	-1	-1	0	Yes
13 (41)	north bank near Charles River dam	67	70	73	75	71	70	-2	-5	5	4	Yes
14 (44)	site of proposed pedestrian overpass near railroad tracks	66	67	72	73	65	66	-7	-7	-1	0	Yes
15 (17)	Edward Everett House on Harvard St.	66	64	73	76	71	74	-2	-2	5	8	Yes
16 (45)	residential buildings on Main St. near court house	63	63	65	66	68	69	3	3	2	3	Yes
17 (46)	residential area along New Rutherford Avenue	73	71	75	75	73	75	-2	0	7	9	Yes
18	residential area adjacent to New Rutherford Avenue	71	70	74	73	72	72	-2	-1	6	6	Yes
19	Bunker Hill Community College - area along New Rutherford Avenue	72	73	75	73	74	74	-1	1	8	8	Yes
20 (47)	Bunker Hill Community College - rear entrance adjacent to train station	70	69	71	72	70	73	-1	1	4	7	Yes
21	Industrial Park - site of proposed residential development	70	72	73	74	72	70	-1	-4	6	4	Yes
22	Industrial Park - site of proposed residential development	69	68	76	76	73	74	-3	-2	7	8	Yes
23 (39)	North Point - near proposed residential development area	61	62	68	69	67	68	-1	-1	1	2	Yes

Source: Bechtel/Parsons Brinckerhoff

¹ In L eq (1 hour) dBA² FHWA NAC³ Numbers in parentheses denote site numbers from the 1991 FSEIS/R

PREDICTED NOISE LEVELS IN 2010
SCHEME Z AND NON-RIVER-TUNNEL ALTERNATIVE¹

Site No.	Site Description	Existing (1993)		Scheme Z		Non-River-Tunnel		Non-River-Tunnel Over Scheme Z		Non-River-Tunnel Alternative Over NAC ²		Noise Abatement to Be Considered
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
1 (27) ³	Charles River Building	68	67	66	68	65	69	-1	1	-1	3	Yes
2 (28)	Paul Revere Landing Park South	69	69	68	70	68	69	0	-1	2	3	Yes
3 (42)	south bank near Charles River dam	71	68	76	77	78	76	2	-1	12	10	Yes
4 (40)	walkways adjoining MBTA commuter railroad bridge	68	69	76	76	73	72	-3	-4	7	6	Yes
5 (43)	Spaulding Rehab. Hospital-riverside benches	62	65	69	69	68	68	-1	-1	2	2	Yes
6	Suffolk County Sheriff's Department jail	67	66	72	71	70	71	-2	0	4	5	Yes
7	residential building at Amy Court and Martha Road	69	69	72	71	72	70	0	-1	6	4	Yes
8 (29A)	Leverett Circle pedestrian walkway	73	70	72	72	74	76	2	4	8	10	Yes
9 (29B)	residential apt. building near outdoor swimming pool	64	63	61	61	61	60	0	-1	-5	-6	No
10	residential area across from Storow Drive	70	68	74	72	72	71	-2	-1	6	5	Yes
11	residential apt. building on Stafford St.	67	67	71	71	72	72	1	1	6	6	Yes
12 (18)	Paul Revere Landing Park North	69	65	68	69	67	69	-1	0	1	3	Yes
13 (41)	north bank near Charles River dam	67	70	73	75	72	72	-1	-3	6	6	Yes
14 (44)	site of proposed pedestrian overpass near railroad tracks	66	67	72	73	65	67	-7	-6	-1	1	Yes
15 (17)	Edward Everett House on Harvard St.	66	64	73	76	71	73	-2	-3	5	7	Yes
16 (45)	residential buildings on Main St. near court house	63	63	65	66	66	66	1	0	0	0	Yes
17 (46)	residential area along Rutherford Avenue	73	71	75	75	73	74	-2	-1	7	8	Yes
18	residential area adjacent to Rutherford Avenue	71	70	74	73	73	72	-1	-1	7	6	Yes
19	Bunker Hill Community College - area along Rutherford Avenue	72	73	75	73	76	75	1	2	10	9	Yes
20 (47)	Bunker Hill Community College - rear entrance adjacent to train station	70	69	71	72	69	72	-2	0	3	6	Yes
21	Industrial Park - site of proposed residential development	70	72	73	74	73	73	0	-1	7	7	Yes
22	Industrial Park - site of proposed residential development	69	68	76	76	72	74	-4	-2	6	8	Yes
23 (39)	North Point - near proposed residential development area	61	62	68	69	68	68	-0	-1	2	2	Yes

Source: Bechtel/Parsons Brinckerhoff

¹ In L eq (1 hour) dBA² FHWA NAC³ Numbers in parentheses denote site numbers in the 1991 FSEIS/R

Impact Classification	Increase Over Existing Level
No Impact	less than 5 dBA
Minor Impact	6 to 10 dBA
Moderate Impact	11 to 15 dBA
Substantial Impact	more than 15 dBA

(Consistent with 1991 FSEIS/R procedures, the above impact classifications are based on an average of several state impact classifications reported in *Highway Traffic Noise in the United States - Problem and Response*, FHWA, April 1986, Revised November 1987. There is no mandated definition of what constitutes a substantial increase over existing noise levels in an area. The above classifications appear to be the most accepted definitions by the states and FHWA.)

Scheme Z: Design year 2010 noise levels with Scheme Z are higher than existing noise levels at 21 out of 23 sites. Decreases in noise levels of 1 to 3 dBA are expected at sites 8 and 9 during both AM and PM periods. At 13 sites, increases over existing levels are 5 dBA or less during the same time periods. More than 5 dBA increase over existing noise levels are estimated at the remaining eight sites (3, 4, 5, 8, 9, 13, 14, 15, 22, and 23), the highest increase being 12 dBA during the PM peak hour at site 15. Since the highest increase is more than 10 dBA at site 15, a moderate impact is expected.

Alternative 8.1D Mod 5: Design year (2010) noise levels with this alternative will be higher than existing noise levels at 20 of the 23 sites. Decreases in noise levels of 1 to 2 dBA are expected at sites 2, 9, and 14 during both AM and PM time periods. At 16 sites the increases over existing levels are 5 dBA or less during the same time periods. More than 5 dBA increases in levels over existing noise levels are estimated at the remaining four sites (3, 10, 15, and 23), the highest increase being 10 dBA during the PM peak hour at site 15 (Edward Everett House on Harvard Street). Since the highest increase is 10 dBA, no substantial impacts are expected at any of the receptor sites for this alternative.

Reduced River-Tunnel Alternative: Similar analysis for the Reduced River-Tunnel Alternative shows that decreases in noise levels of 2 to 4 dBA are estimated at two sites, 9 and 14. At 16 sites noise level increases of 5 dBA or less are estimated. Noise level increases of more than 5 dBA are estimated at five sites (3, 15, 16, 22, and 23), the largest increase of 10 dBA occurring at site 15 during the PM peak period. Since the noise levels do not increase by more than 10 dBA at any of the 23 sites, no substantial impacts are predicted for this alternative.

Non-River-Tunnel Alternative: For this alternative decreases in noise levels of 1 to 3 dBA are estimated at three sites (2, 9, and 14). At 14 sites noise level increases of up to 5 dBA over existing noise levels are estimated. Noise level increases of more than 5 dBA are estimated at six sites (3, 5, 8, 15, 22, and 23), the largest increase of 9 dBA occurring at site 15 during the PM peak period. Since the future noise levels do not increase by more than 10 dBA, no substantial impacts are predicted at any of the 23 sites during both AM and PM peak periods.

Comparison With FHWA Criteria. Noise levels with Scheme Z and three new proposed alternatives approach or exceed the FHWA outdoor NAC of $L_{eq}(1 \text{ hour}) = 67 \text{ dBA}$ (category B sites; "approach" level in Massachusetts = 66 dBA) at 22 of the 23 sites. Future baseline noise levels also exceed the FHWA criteria at the same 22 out of the 23 sites. The existing noise levels currently approach or exceed the FHWA criteria at 19 out of the 23 sites. The affected sites include existing and proposed residential land uses and extensive waterfront recreational areas. If noise levels approach these criteria, abatement must be considered (see Section 4.4.1(c)).

Comparison With Future Baseline Levels. Predicted future 2010 noise levels under the alternatives are presented in Tables 4.33 to 4.35. A comparison of noise levels under Scheme Z, used as a baseline level, with the noise levels for the alternatives shows that a large number of sites experience decreases in noise levels under the new design alternatives; 15 sites during the AM and 12 sites during the PM for Alternative 8.1D Mod 5; 17 sites during the AM and 13 sites during the PM for the Reduced River-Tunnel Alternative; and 13 sites during the AM and 15 sites during the PM for the Non-River-Tunnel Alternative. Compared to the future baseline conditions, four to six sites experience increases in noise levels for all three new design alternatives compared to future baseline conditions at the same sites. In all of these cases the increases are 3 dBA or less, except in the Non-River-Tunnel Alternative, where the increase is 4 dBA at one site during the PM period. Compared to Scheme Z and the two other alternatives, the Reduced River-Tunnel Alternative has marginally less noise impact as shown by the slight increase in the total number of receptor sites that experience reduced noise levels under this alternative (see Table 4.36).

Ventilation Noise Levels. Noise from proposed ventilation building(s) results from operation of the fans used for tunnel supply air and exhaust. The amount of noise generated by such fans depends on the number and type of fans, their sizes and air volume flow rates, the pressure drop across the fans, and their operating efficiency. The resulting level of fan noise at any noise sensitive receptor in the community further depends on the specific design configuration of the ventilation duct system, the control equipment designed for the fans, and on the distance and orientation of the ventilation building air intake and exhaust openings relative to the given receptor position (see the 1991 FSEIS/R Noise and Vibration Appendix for details of ventilation building noise prediction methodology).

Under Scheme Z there are no ventilation buildings in the Area North of Causeway Street because there are no tunnel sections. One ventilation building is required for Alternative 8.1D Mod 5 and the Non-River-Tunnel Alternative. Two ventilation buildings are required for the Reduced River-Tunnel Alternative.

The ventilation building on the south bank of the Charles River for Alternative 8.1D Mod 5 is built above grade with exhaust and fresh air intake stacks extending beyond the top of the building. In addition, this single building has greater ventilation capacity resulting in more noise generated. Therefore, noise impacts from this building for this alternative are expected to be greater. Ventilation buildings for the Reduced River-Tunnel and Non-River-Tunnel Alternatives are constructed below grade, with exhaust and air intake stacks above grade. Ventilation buildings and associated equipment for the three alternatives will be designed to meet the Project design criteria which are detailed in the 1991 FSEIS/R and which are consistent with the City of Boston Code, Ordinances, Title 7, Section 50.

Preliminary assessment of noise from ventilation buildings (specifically from fans and ducting) without sound attenuation measures include the following results (see Table 4.37). No violations of the DEP noise criterion (i.e., an increase of 10 dBA or more over ambient levels) occur at the residential sites in the proposed North Point development area, either during daytime or nighttime. For Alternative 8.1D Mod 5, daytime noise levels at one institutional site (Suffolk County Jail) exceed the DEP criterion by 2 to 5 dBA and at one office site by 3 dBA for ventilation building 8. Nighttime noise levels for the same alternative at the same sites exceed the DEP criterion by 3 to 8 dBA. Sound attenuation measures will be provided for the ventilation building for Alternative 8.1D Mod 5 to satisfy the City of Boston noise ordinance property line noise criteria for noise from a stationary noise source. Property line noise levels will be determined in the subsequent design phase when more specific information on fan noise levels will be available.

Table 4.36

**NUMBER OF SITES WITH CHANGES IN
PREDICTED NOISE LEVELS (dBA) IN 2010 FOR
EACH ALTERNATIVE COMPARED TO SCHEME Z**

Change In Noise Level	Alternatives					
	8.1D Mod 5		Reduced River-Tunnel		Non-River-Tunnel	
	AM	PM	AM	PM	AM	PM
4	-	-	-	-	-	1
3	1	-	2	1	-	-
2	2	3	1	1	2	1
1	2	1	2	4	3	2
0	3	7	1	4	5	4
-1	6	3	7	4	5	10
-2	6	6	6	4	5	1
-3	1	-	2	1	1	2
-4	1	1	-	1	1	1
-5	-	-	1	1	-	-
-6	-	-	-	1	-	1
-7	-	1	1	1	1	-
-8	1	-	-	-	-	-
Total no. of sites with 1 dBA or greater increase	5	4	5	6	5	4
Total no. of sites with 1 dBA or greater decrease	15	12	17	13	13	15

Source: Bechtel/Parsons Brinckerhoff

Table 4.37

PREDICTED VENTILATION BUILDING NOISE IMPACTS NEAR SELECTED LAND USES

Alternative	Vent Building No.	Adjacent And Other Nearby Land Uses			Fan Noise Levels (dBA)				Ambient Noise Levels		Increase Over Ambient Noise Levels (dBA)			
		Description	Land Use	Approx. Distance (ft.)	Day		Night		Day	Night	Day		Night	
					Exhaust	Supply	Exhaust	Supply			Exhaust	Supply	Exhaust	Supply
8.1D Mod 5	8	Suffolk County Jail	institutional	200	75	72	68	65	60	50	15	12	18	15
8.1D Mod 5	8	Registry building	office	250	73	70	66	63	60	50	13	10	16	13
Reduced River-Tunnel	8	Registry building	office	220	60	57	55	52	60	50	0	-3	5	2
Reduced River-Tunnel	8	Spaulding Hospital	hospital	300	57	54	52	49	60	50	-3	-6	2	-1
Reduced River-Tunnel	8	office	office	170	62	59	57	54	60	59	2	-1	-2	-5
Reduced River-Tunnel	9	housing (Charlestown)	residential	600	54	51	49	46	59	49	-5	-8	0	-3
Non-River-Tunnel	8	Suffolk County Jail	institutional	150	62	59	57	54	60	50	2	-1	7	4
Non-River-Tunnel	8	Registry building	office	100	66	63	61	58	60	50	6	3	11	8

Notes:

1. Daytime exhaust conditions are based on emergency ventilation airflow.
2. Daytime supply conditions are based on maximum normal ventilation airflow.
3. Nighttime supply and exhaust conditions are based on 37 percent of maximum normal ventilation airflow.
4. Results presented do not include sound attenuation measures.
5. L90 means noise level will be exceeded 90 percent of the time.
6. Nighttime ambients are assumed to be 10 dBA below daytime ambient levels.

Source: Bechtel/Parsons Brinckerhoff

For the other two alternatives, ventilation building noise levels satisfy the DEP criterion of not exceeding the existing ambient noise levels by more than 10 dBA during both daytime and nighttime.

4.4.1(c) Mitigation Measures: Noise

An area or land use must be considered for noise abatement if the predicted traffic-related noise levels either approach or exceed the FHWA NAC or substantially exceed the existing noise levels. Either of these two conditions represents a noise impact. Abatement measures are to be considered to the extent reasonable opportunities exist to control noise. Abatement analysis follows the procedures outlined in 23 CFR 772. A discussion of various options to control Project-related traffic noise is provided in the 1991 FSEIS/R, and the discussion concludes that the only reasonable abatement measure would consist of erecting noise barriers within the right-of-way.

Noise Barrier Analysis. Noise barriers have been considered where the total projected traffic noise levels approach or exceed the FHWA NAC at all sites with external use except at site 9 where there is no noise impact under any of the alternatives. Where feasible and reasonable, noise barriers are recommended. Recommendations made in the 1991 FSEIS/R are still valid for Scheme Z and are applicable for the alternatives for all of the receptor sites. In addition to the noise barriers that are recommended at sites 15, 16, 17, and 20 in the 1991 FSEIS/R, noise barriers are evaluated at four new sites (10, 11, 19, and 21) for this DSEIS/R.

- At receptor site 10 (residences across from Storrow Drive), the Project noise levels exceed NAC by 4 to 9 dBA under all three new design alternatives. A 13-to 15-dBA noise reduction is achievable for the ground-level receptors of the residential buildings at receptor site 10 with a 500-foot-long and 14-foot-tall barrier. At an estimated cost of \$119,000, a continuous long barrier is not feasible at this site without severely limiting access to the residences. Therefore, a barrier at this site is not recommended.
- At receptor site 11 (residential apartment building on Stafford Street), the Project noise levels exceed FHWA NAC by 4 to 5 dBA under all three alternatives. At an estimated cost of \$130,900, a 550-foot-long and 14-foot-tall barrier provides a noise reduction of 12 to 15 dBA to the ground-level receptors of this apartment building. Though acoustically effective, a long continuous barrier is not considered feasible at this site without severely limiting access to the residences along the street. Therefore, a barrier at this site is not recommended.
- At receptor site 19 (Bunker Hill Community College), noise levels under the alternatives are 6 to 9 dBA above FHWA NAC levels. This site represents an institutional land use and may require mitigation. A 13- to 15-dBA noise reduction is achieved at receptor site 19 with a 1,240-foot-long, and 14-foot-tall barrier. At an estimated cost of \$295,120, this barrier is feasible and reasonable and is recommended.
- At receptor site 21, (proposed North Point development site) noise levels under the alternatives are from traffic on the Gilmore Bridge and are estimated to be 5 to 9 dBA above FHWA NAC levels. This site is proposed for future residential development, and would need mitigation if developed. A 12- to 15-dBA reduction can be achieved at this site with a 1,200-foot-long, 8-foot-tall structural barrier erected on the bridge. At an estimated cost of \$165,000 to 200,000, this barrier is feasible and reasonable, and is recommended if such development is carried out.

Noise mitigation needs to be studied further as part of the subsequent design process for the preferred alternative and the mitigation implementation process for the Charles River parkland and for the Charlestown neighborhood. Construction of the recommended noise barriers will be reviewed and a

decision will be made during the subsequent design phase with input from the MDC and affected citizen representatives.

4.4.2 Vibration

4.4.2(a) Affected Environment

Vibration-sensitive land uses in the Project area include residential, commercial, institutional, and industrial buildings. The potential long-term effects of vibration at such locations include structural damage, annoyance to building occupants, and/or interference with sensitive manufacturing processes. These concerns are greater during the construction phase than during the operations phase of the Project (see Section 5.9).

Existing Vibration Levels. The basic unit used in measuring vibration levels is the vibration velocity in inches per second (in/sec). Detailed information on the methodology to obtain vibration levels and criteria used for assessing vibration impacts are presented in the 1991 FSEIS/R and in its Noise and Vibration Appendix. This information is not repeated here. Vibration measurements were made during April 1993 to document the existing vibration levels at seven locations (see Figure 4.28 A). Descriptions of these locations and the measured peak vibration velocities are presented in Table 4.38. Results of the vibration measurement program indicate that the existing vibration levels are in the range of 0.001 to 0.025 in/sec. These velocities are just within the perceptible range, and are caused principally by motor vehicles on adjacent roads. Higher vibration levels measured in two industrial facilities are due to machinery operating within the facilities. These machinery-generated vibration levels are higher than vibration levels caused by road traffic in the area.

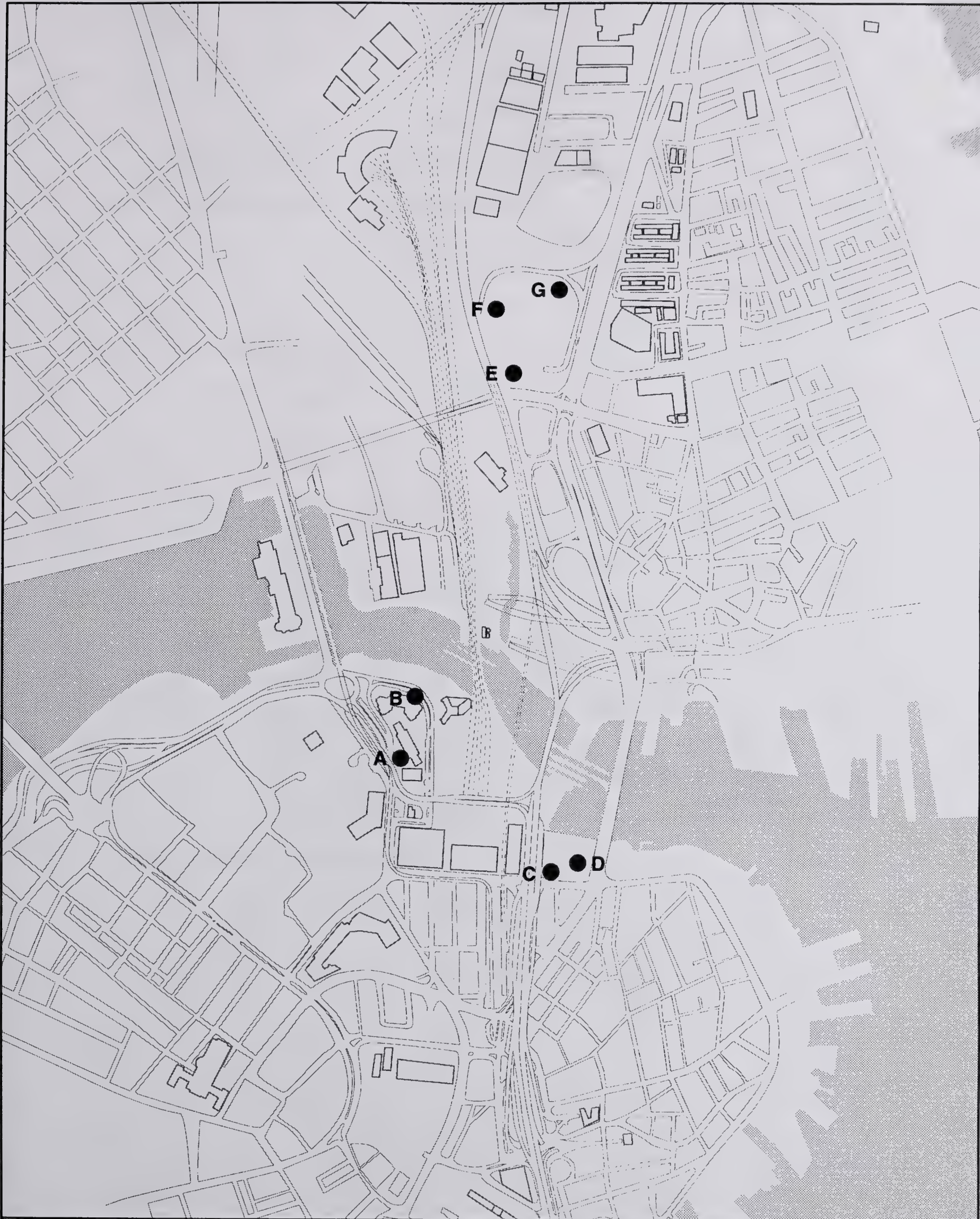
4.4.2(b) Impacts

The severity of vibration effects is assessed by comparing anticipated long-term vibration levels at sensitive receptors with existing vibration levels and with Project vibration criteria. The vibration velocity levels that would cause minor architectural damage are in the range of 0.12 in/sec for historic structures and 0.2 in/sec for nonhistoric structures. Typically, a heavy truck passing by generates a velocity level in the range of 0.003 in/sec, considerably lower than the damage criterion of 0.12 in/sec. As a result, future traffic vibrations do not cause any damage to historic and nonhistoric structures.

Traffic-induced vibration could be annoying to people inside buildings. Effects of traffic vibration are assessed based on the maximum amplitude of vibration caused by a single vehicle rather than on traffic volumes. Typically, vehicles at 50 feet generate vibration velocities in the range of 0.001 in/sec for automobiles to 0.003 in/sec for heavy trucks. The criteria for annoyance and disruption of sensitive equipment are in the range of 0.005 in/sec for hospitals and 0.04 in/sec for factories. These levels are higher than the vehicle-generated levels and they are not exceeded by the operation of any of the three alternatives.

4.5 AQUATIC RESOURCES IMPACTS

The 1991 Proposed Action (Scheme Z) and the three new design alternatives affect aquatic resource areas including Federal and State jurisdictional wetlands and waterways, navigation of the Lower Charles River Basin, fisheries, water quality, and other aquatic resources (e.g., floodplains, coastal areas) as described in this section. Because of these impacts, MHD has coordinated extensively with Federal, State, and local agency personnel through a Water Resources Subcommittee (WRS) of the Project's Interagency Coordinating Committee. This Subcommittee was convened by MHD so that agency concerns and regulatory responsibilities could be coordinated and considered early in the design and planning process. The WRS consists of members of the Project team and representatives of appropriate agencies (Federal,



FIGURE

4.28A

Vibration Monitoring Sites

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



Table 4.38

EXISTING VIBRATION LEVELS AT SELECTED STRUCTURES

Site¹	Description	Range Of Peak Vibration Velocity (inches per second)	Major Existing Vibration Source
A	100 Nashua Street, south entrance to loading dock	0.002	Leverett Circle on-ramp traffic
B	Suffolk County Jail basement	0.001	Nashua Street
C	Charles River Building south end basement level	0.002	off-ramp to Storrow Drive
D	131 Beverly Street, S.W. corner of buildings	0.003	off-ramp to Storrow Drive
E	Bunker Hill Community College mechanical room buildings	0.001-0.0032	traffic on I-93
F	recycling center, 440 Rutherford Avenue	0.015	trucks on weigh scales
G	publishing house, 440 Rutherford Avenue	0.018-0.025	printing machines

Source: Bechtel/Parsons Brinckerhoff

¹ See Figure 4.28A for location of sites where existing vibration measurements were taken, 1993.

State, and local) which have authority to comment and review, issue concurrence, or issue permits for Project activities which affect either coastal or inland water resources.

Three major regulatory programs exercise jurisdiction in the Charles River and Millers River. The Federal Clean Water Act and its implementing regulations control the placement of fill in waters of the United States, including associated wetland areas. The purpose of the program is to insure the ecological integrity of the nations wetlands and to protect and improve the quality of water resources.

The State Wetlands Protection Act and implementing regulations set forth the purposes of the program, which include; the protection of public and private water supply, ground water supply, land containing shellfish, fisheries and wildlife habitat; the prevention of pollution and storm damage; and flood control. These objectives are achieved through the implementation of performance standards for work within regulated wetland resource areas, in order to assure that the important functions of wetland resource areas are not adversely impaired.

Chapter 91 and implementing regulations exercise jurisdiction over tidelands and waterways. Among the principal goals of the waterways licensing program are to promote and protect tidelands as a locus for water-dependent activities; to provide pedestrian access to and along the waterfront and to enhance public use and enjoyment of these areas; to protect Areas of Critical Environmental Concern (ACEC) and ecologically significant areas from the impact of filling and structures; to support the revitalization of urban waterfronts in a manner that promotes public use and enjoyment and to encourage the coordination of local and state planning for the waterfront land use.

This section and Section 5.10.1 assess the permanent and temporary construction period effects, respectively, of the alternatives on the aquatic resources and provide the factual analysis relating to applicable standards for each of these regulatory programs.

4.5.1 Wetlands

Since mid-1992, MHD in coordination with the WRS has been preparing a Projectwide Wetlands and Waterways Mitigation Program which includes a functional evaluation of wetlands and waterways resources.

The wetlands resources in the Area North of Causeway Street are regulated under both Federal and State laws. Wetlands resources are defined by both the Federal Clean Water Act and its implementing regulations (U.S.C. sec. 1344, 33 CFR 328.2, and 40 CFR 230.3) and the Massachusetts Wetlands Protection Act and implementing regulations (MGL c. 131, s. 40 and 310 CMR 10.00). The following sections describe the permanent impacts and mitigation of Scheme Z and the three new design alternatives on the aquatic resources by ecological factors and by individual regulatory program. A summary of wetlands impacts is in Section 4.5.1(c).

4.5.1(a) Federal Wetlands Jurisdiction

Affected Environment. The study area includes the portion of the Charles River upstream of the existing MDC dam and downstream of the old Charles River dam (now the location of the Science Museum and the O'Brien Highway) as well as the adjacent Millers River (see Figure 4.29). The surrounding area is highly developed and urbanized, being occupied mostly by transportation and industrial uses. In the Charles River, the riverbanks consist mostly of vertical seawalls and sloped rubble or riprap banks, and in the Millers River they are steep, and consist of mud and silt, rubble, and stone riprap. Vegetation along both rivers is minimal; it is limited to narrow bands of successional weed

species along portions of the riverbanks. Land adjacent to the Charles and Millers Rivers is highly disturbed and public access to the area is limited. The Millers River has poor water quality.

Methodology. Federal jurisdiction in inland areas includes nontidal waters up to the ordinary high water mark and, where present, any adjacent wetlands which are designated as a "special aquatic site" as defined under Section 404 Regulations. The boundary of nontidal waters was delineated by including all land under water extending to ordinary high water (el. 103.5). Wetland boundaries were established in the field during preparation of the 1991 FSEIS/R using the Federal "three-parameter" method that includes vegetation, soil, and hydrology (FICWD 1989). The boundaries were updated in 1993 using the 1987 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* as a guide.

The Charles River and the Millers River are inland water bodies which are separated from the Boston Harbor coastal waters by a U.S. Army Corps of Engineers (USACE)-constructed dam and lock system installed in 1976. The mean annual flow from the Charles River is approximately 450 cubic feet per second (cfs) and the 7-day, 10-year low flow is approximately 22 cfs. The Millers River is an inlet to the Charles River, connecting to it through two 84-inch culverts located approximately 900 feet upstream of the MDC dam/flood control pumping station. Because of its hydraulic connection to the Charles River, the water levels and other hydrologic and hydrographic conditions in the Millers River are controlled by the conditions in the Charles River. There is no surface connection between the Charles and Millers Rivers.

The Millers River is nearly surrounded by a narrow band (1 foot to 5 feet wide) of wetlands as defined by Federal regulations. The boundary of the wetlands was established at an elevation of about 104 feet. Approximately 17,600 sf of Federally defined wetlands surround the Millers River. The dominant plant of these wetlands is common reed, *Phragmites australis*, an introduced plant with little wildlife habitat value. Approximately 2,175 sf of wetlands dominated by indigobush, *Amorpha fruticosa*, are found on a portion of the banks of the Charles River near its confluence with the Millers River.

Wetlands Functions And Values: The existing functions and values of the affected areas of the Charles River and the Millers River have been evaluated twice. In the first evaluation, performed for the 1991 FSEIS/R, the functions and values of these aquatic habitats were evaluated using a methodology based on the Wetlands Evaluation Technique (WET 1.0 and 2.0) that was developed by Adamus, et al (1987). During the development of the subsequent Projectwide Wetlands and Waterways Mitigation Program, the evaluation method was further refined to address agency comments and concerns about the suitability of those methods in identifying ecological values and to include State wetland functions. That process identified the following aquatic functions that nontidal waters and wetlands could potentially perform:

- groundwater recharge
- nutrient export
- groundwater discharge
- aquatic diversity/abundance
- groundwater supply
- flood storage and desynchronization
- fish habitat
- sediment and shoreline stabilization
- wildlife habitat
- nutrient retention and transformation
- endangered species
- surface water supply
- sediment/toxicant retention



FIGURE

4.29

Federal Aquatic Resource Areas

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 400 800 1600 2400 FEET



The value of these functions for the Charles River and the Millers River was then determined using this methodology. The analysis found that not all of the biological or chemical functions listed above perform at the highest level in either river. In some cases, they are performed poorly or not at all. Groundwater supply and surface water supply are nonfunctioning in both water bodies. Similarly, the natural flood storage and desynchronization function of both water bodies is low to nonexistent. While the Charles River provides an artificially controlled flood storage function, the water level of the river is controlled by the dam; thus it provides limited to no natural flood control. Because of the degraded overall quality of the aquatic resources and the presence of the Charles River dam, and highway and railroad bridges in this area, there are a limited number of functions performed by these water bodies.

Currently, there is almost no means of access by wildlife, except birds, to the Charles River and the adjacent Millers River, as the rivers and their narrow fringes of vegetation are entirely surrounded by industrial land. Disturbance from adjacent industrial land uses, poor water quality, and low-quality vegetation severely limit wildlife habitat suitability. The Charles River, because it contains fish, may serve as a feeding area for cormorants. The Millers River has low significance as a wildlife habitat.

Both rivers perform certain functions of nontidal wetland resources. Those functions which a water body or wetland perform well are termed principal valuable functions (PVF). The WRS agencies, during the development of the Projectwide Wetlands and Waterways Mitigation Program, established that PVFs would include only those functions and values that display a significance in any of the identified resources during existing baseline condition. Significance was determined by the agencies to include only those functions and values that received ratings of high or moderate during the evaluation of functions and values. Those functions and values that were rated low or nonfunctional are not included as PVFs. Based on those evaluations, the PVFs are as follows:

Charles River

sediment and shoreline stabilization
sediment/toxicant retention
nutrient retention and transformation
fish habitat

Millers River

sediment/toxicant retention
nutrient retention and transformation

Description Of Proposed Work. The permanent impacts evaluated in this DSEIS/R are based on a conceptual design and therefore it is not known where the exact location of piers, viaducts, tunnels, or at-grade ramps will be. Permanent impacts are shown in Table 4.39 and shown in Figures 4.30 through 4.37.

Scheme Z (see Figures 4.30 and 4.31) affects 0.10 acres of nontidal waters in the Charles River due to the placement of piers. This alternative also results in minor impacts to wetlands in the Millers River due to the placement of piers which displace less than 0.002 acres of wetlands and 0.01 acres of nontidal waters.

Alternative 8.1D Mod 5 (see Figures 4.32 and 4.33) places one pier in the Charles River. This alternative also places bridge piers and fill in the Millers River for access ramps displacing 0.010 acre of nontidal waters. Approximately 0.20 acre of wetlands and 1.1 acres of nontidal waters will be lost in the Millers River. In this alternative, a tunnel will be placed under the mudline of the Charles River. This activity is not expected to have a permanent impact to Federal resource areas but will result in extensive temporary impacts resulting in disturbance of 1.9 acres of nontidal waters as described in Section 5.10.1.

The Reduced River-Tunnel Alternative (see Figures 4.34 and 4.35) places piers in the Charles River, resulting in the displacement of 0.02 acre of nontidal waters. This alternative places bridge piers and fill for access ramps in the Millers River resulting in the displacement of 0.20 acre of wetlands and 1.1 acres of nontidal waters. In this alternative a tunnel will be placed under the mudline of the Charles River. This activity is not expected to have a permanent impact to Federal resource areas but will result in extensive temporary impacts resulting in disturbance of 1.7 acres of nontidal waters as described in Section 5.10.1.

The Non-River-Tunnel Alternative (see Figures 4.36 and 4.37) is similar in permanent impacts to Alternative 8.1D Mod 5 with regard to Federal resource areas.

In Scheme Z and the three new design alternatives, indirect loss of some wetlands may result from the shading impacts of viaducts over the Millers River. Scheme Z and the three new design alternatives will remove the existing I-93 piers (except for Pier "A", the reverse banana pier) which currently occupy 0.06 acres of nontidal waters.

Impacts. This section assesses impacts on Principal Valuable Functions (PVF). Scheme Z and the three new design alternatives result in some direct loss of nontidal waters and wetlands. However, the effects of these impacts on the PVF in each water body are insignificant, as explained below.

Sediment And Shoreline Stabilization: The banks will be constructed with riprap which will continue to protect the shoreline from erosive currents (winds and boat wake) after construction. Therefore, under any alternative, none of the permanent alterations in the Charles River or the Millers River creates adverse impacts on sediment and shoreline stabilization.

Sediment/Toxicant Retention: The ability of the Millers River to function as a detention basin for area runoff, erosion, and sedimentation, and its ability to provide sediment/toxicant retention potentially could be decreased as a result of reduction in the surface area of the river for all alternatives. If this is proven to be true, appropriate mitigation measures will be implemented.

In the Charles River, Scheme Z has the greatest number of piers, resulting in minor impact to sediment/toxicant reduction. The three new design alternatives result in a net increase in water volume and surface area, thereby improving these functions.

Nutrient Retention And Transformation: The Charles River and the Millers River provide this function in a similar manner to sediment/toxicant retention. However, this function is related more to wetlands quality and whether nutrients are suspended in the water column. It is likely that any potential decrease in function under any alternative can be mitigated.

Fish Habitat: None of the designs results in permanent impacts to the Charles River fisheries. Fish habitat is not a PVF for the Millers River.

Summary: All alternatives result in insignificant impacts to the PVFs of the Charles and Millers Rivers.

4.5.1(b) 404(b)(1) Regulatory Analysis

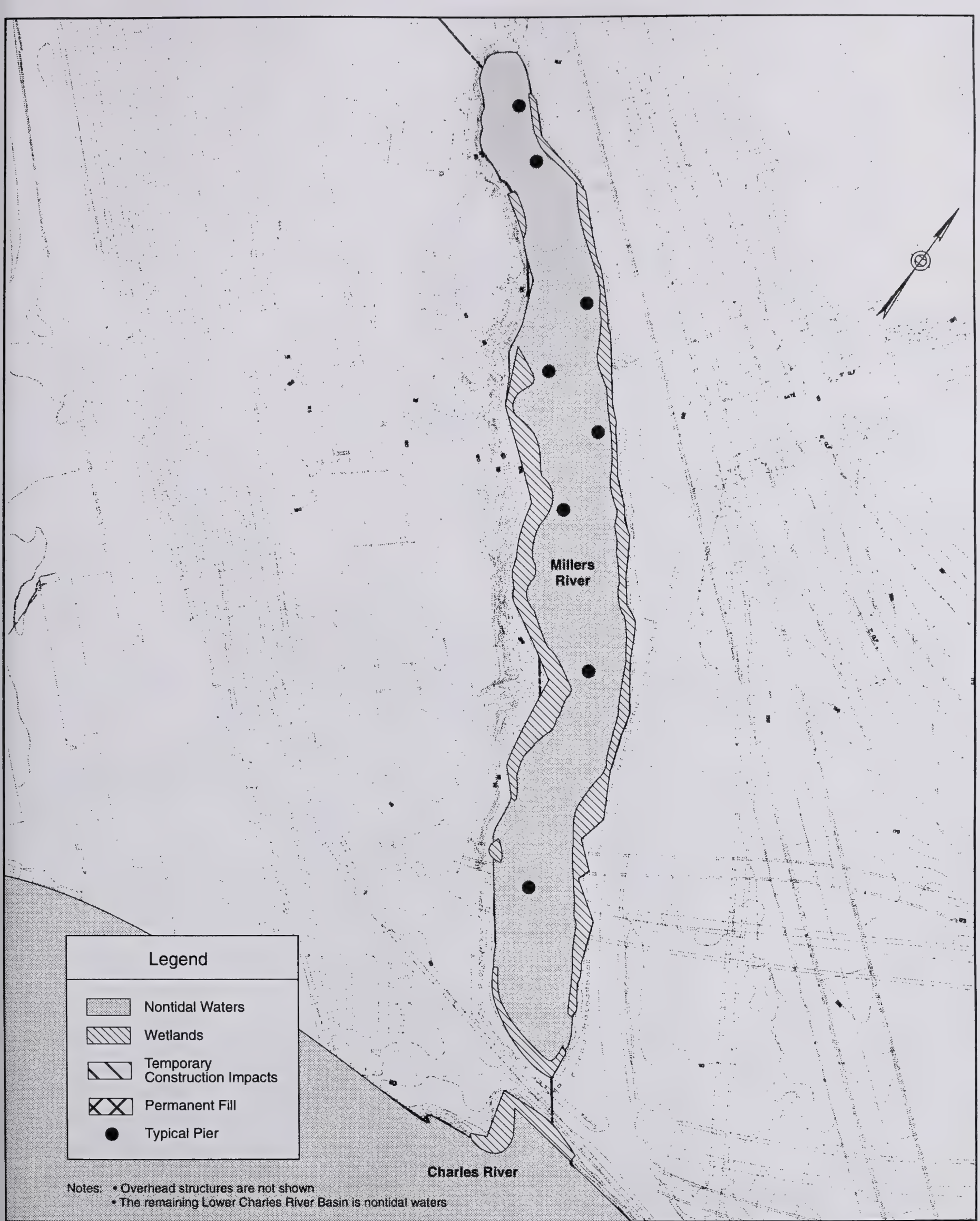
Since Scheme Z and the three new design alternatives involve dredging and filling in the Charles River and in the Millers River, an application for a permit to conduct these activities has been submitted to the U.S. Army Corps of Engineers (USACE) pursuant to Section 404 of the Clean Water Act. As a part of its review of the permit application, USACE will apply guidelines published at 40 CFR Part 230, usually referred to as 404(b)(1) Guidelines. The purpose of these Guidelines is "to restore and maintain the

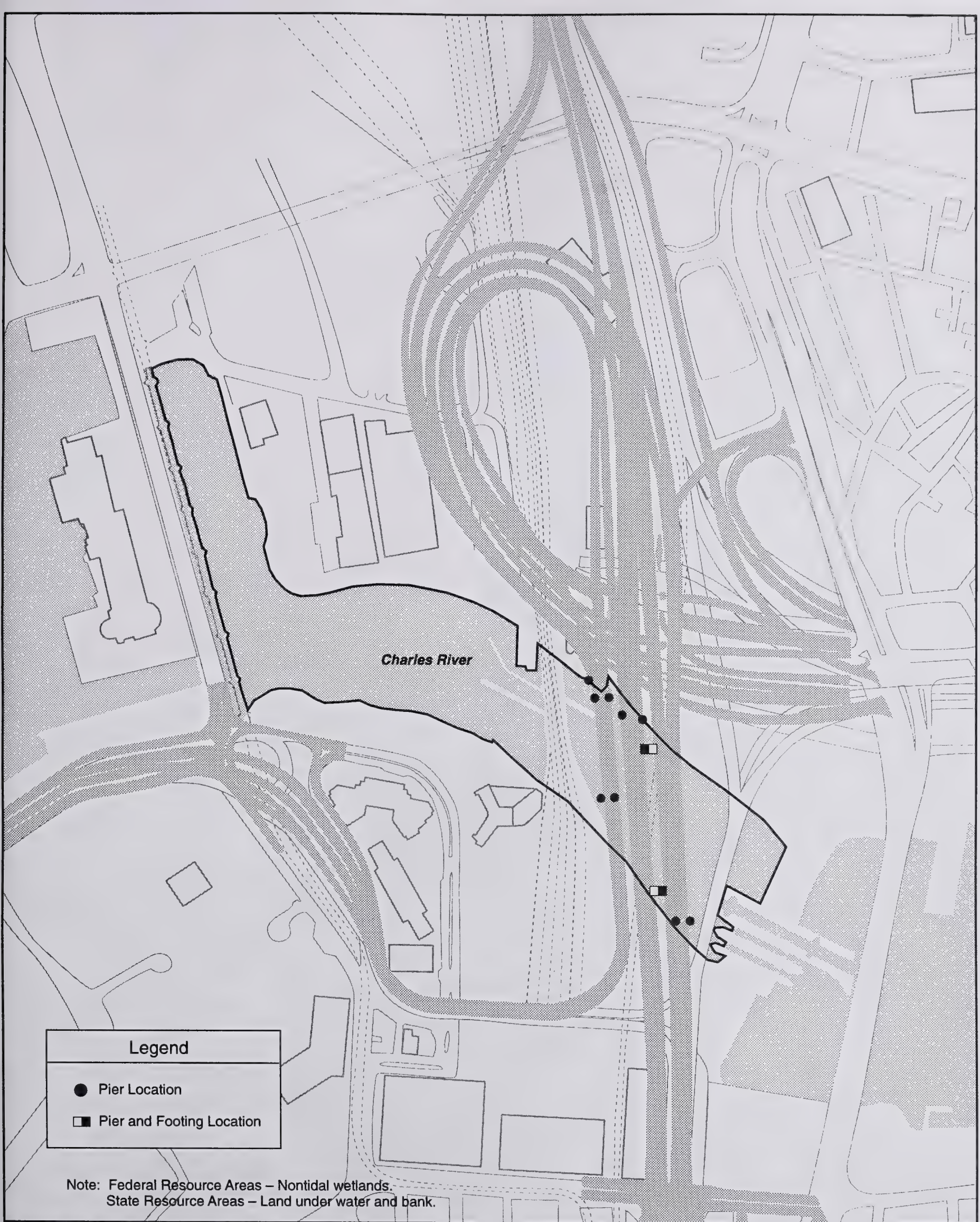
Table 4.39
PERMANENT IMPACTS TO FEDERAL WETLAND RESOURCE AREAS

Alternative	Wetland Resource Category	
	Nontidal Water (acre)	Wetlands (acre)
Millers River		
Scheme Z ¹	0.01	0.002
8.1D Mod 5 ²	1.1	0.20
Non-River-Tunnel	1.1	0.20
Reduced River-Tunnel	1.1	0.20
Charles River		
Scheme Z	0.10	N/A
8.1D Mod 5	0.01	N/A
Reduced River-Tunnel	0.02	N/A
Non-River-Tunnel	0.01	N/A

¹ The impacts have been recalculated to reflect current pier dimensions and construction methods for the Millers River, thus differing from those included in the 1991 FSEIS/R.

² The impacts have been recalculated to reflect current construction methods thus differing from those included in the Notice of Project Change.





FIGURE

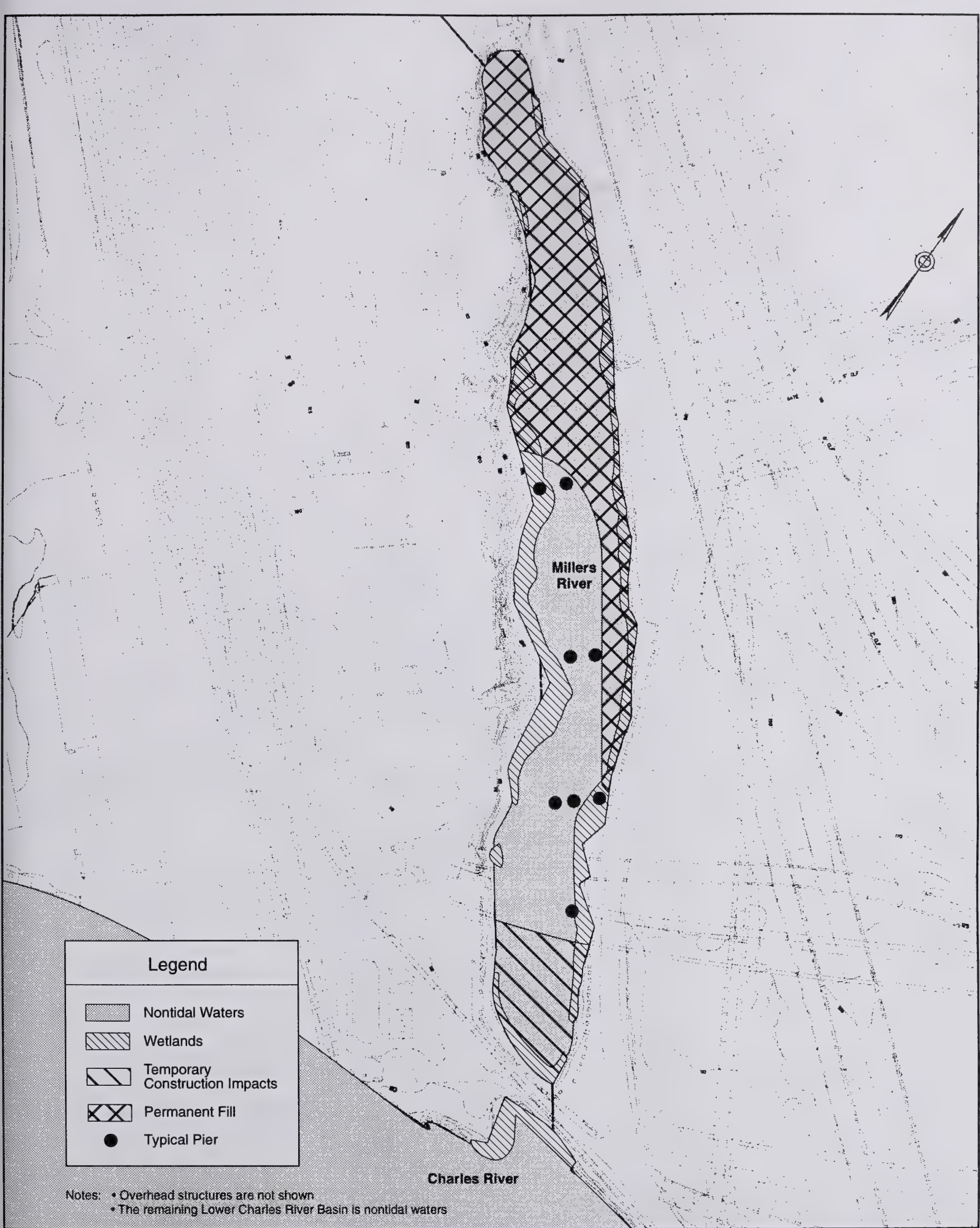
4.31

Affected Aquatic Resources Areas; Charles River: Scheme Z Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 100 200 300 400 FEET





FIGURE

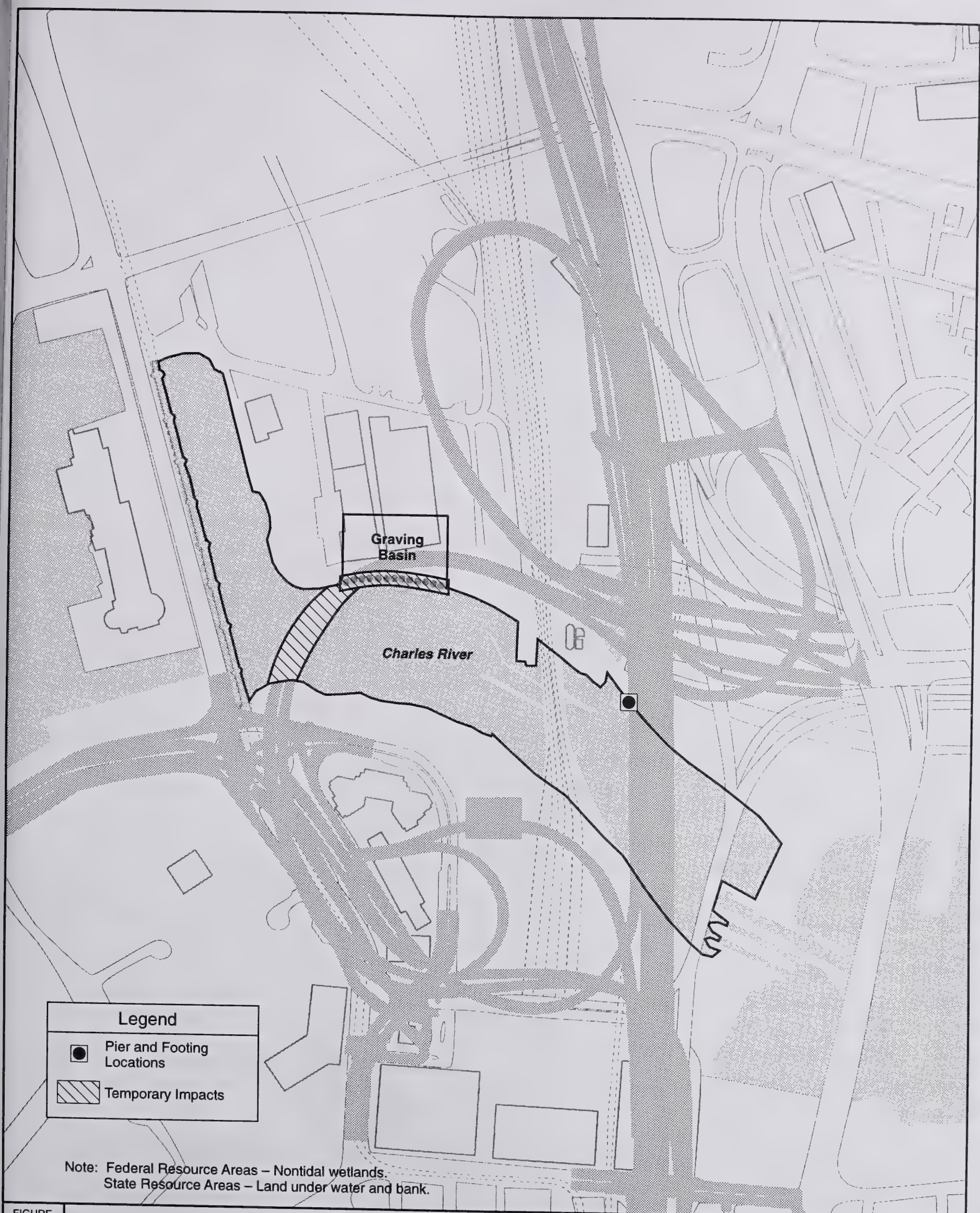
4.32

**Affected Federal Aquatic
Resource Areas; Millers River :
Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 400 800 1600 2400 FEET





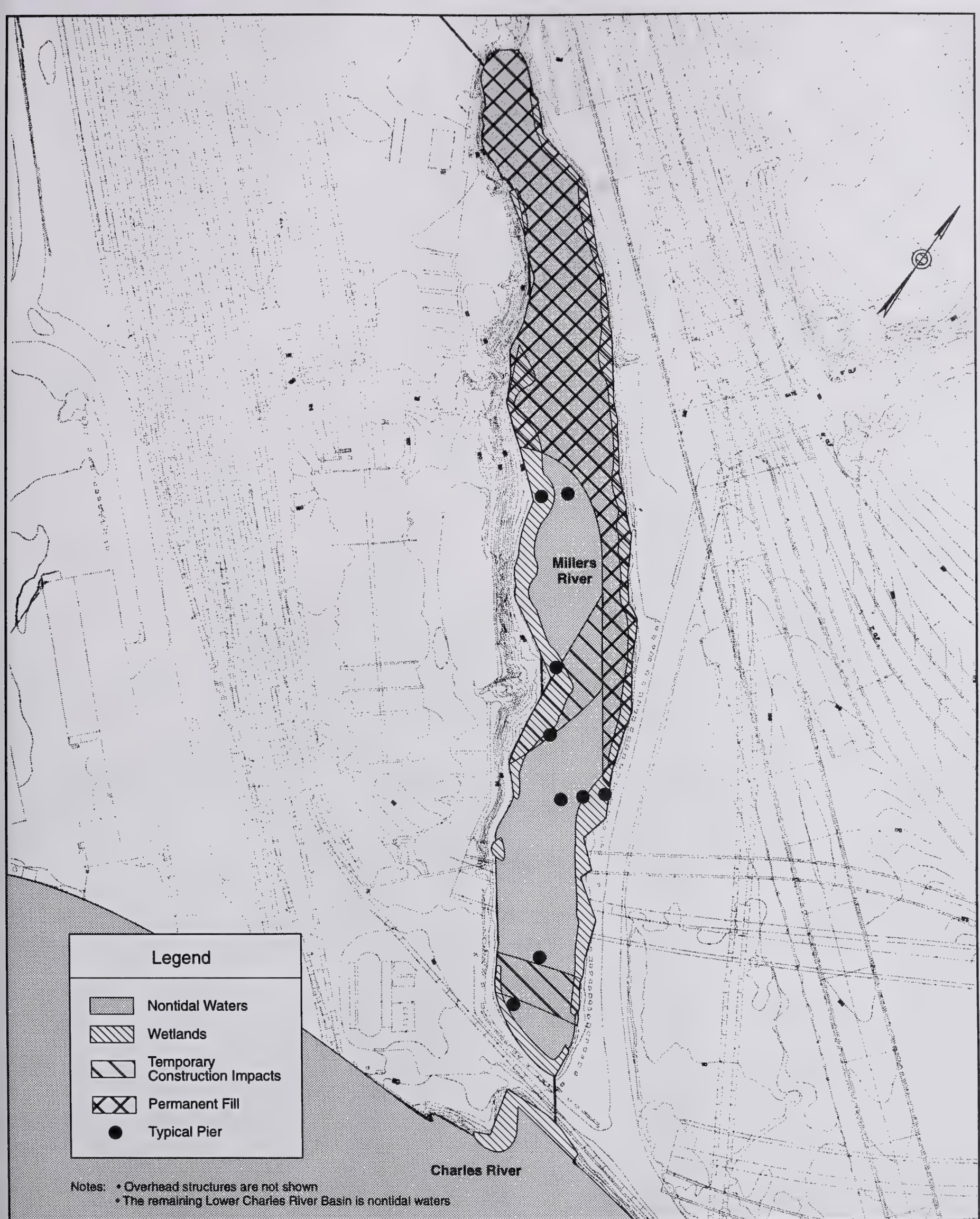
FIGURE

4.33

Affected Aquatic Resource Area;
Charles River:
Alternative 8.1D Mod 5
 Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
 CENTRAL ARTERY/TUNNEL PROJECT

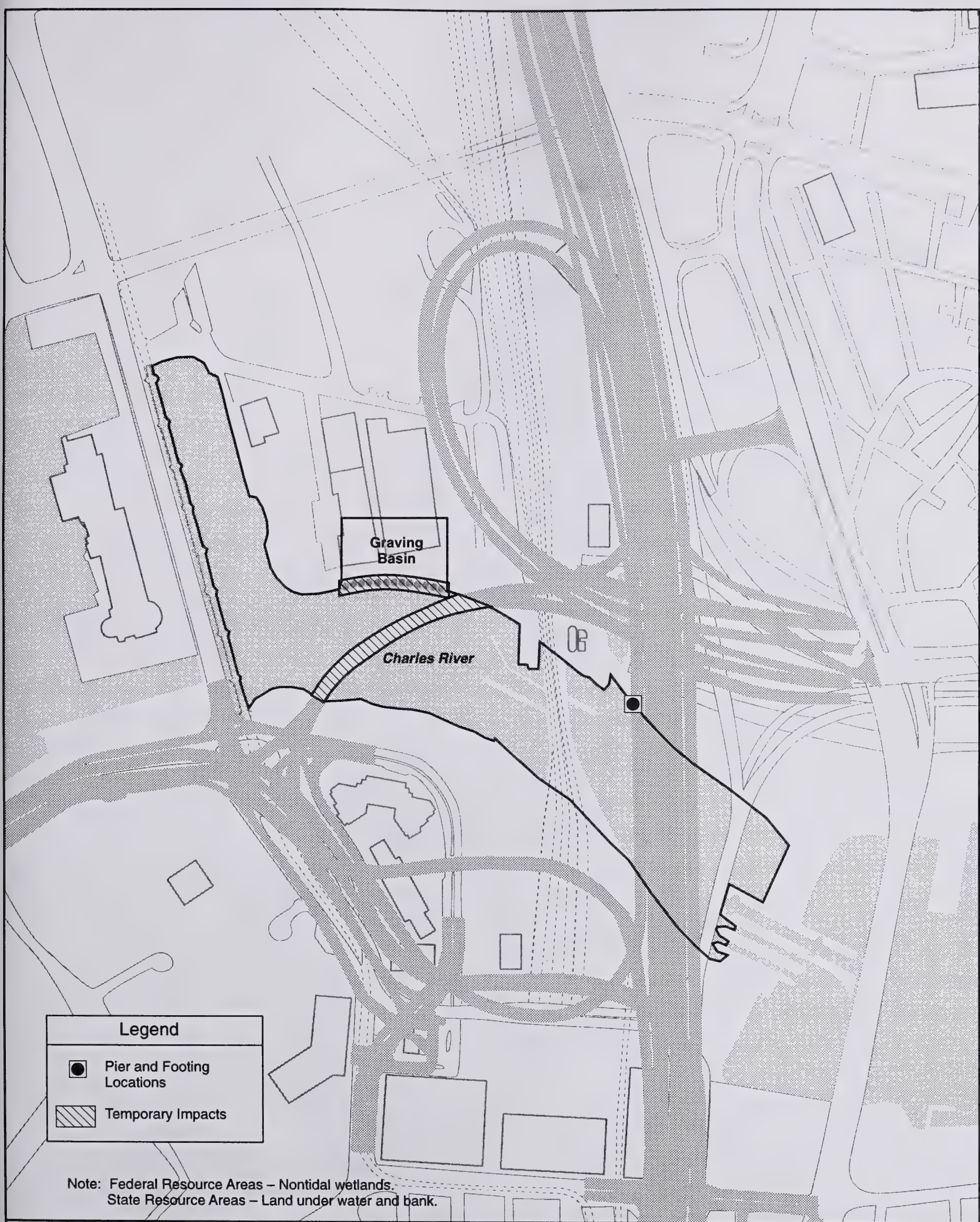




FIGURE

4.34

**Affected Federal Aquatic
Resource Areas; Millers River :
Reduced River-Tunnel Alternative**
Charles River Crossing DSEIS/R



FIGURE

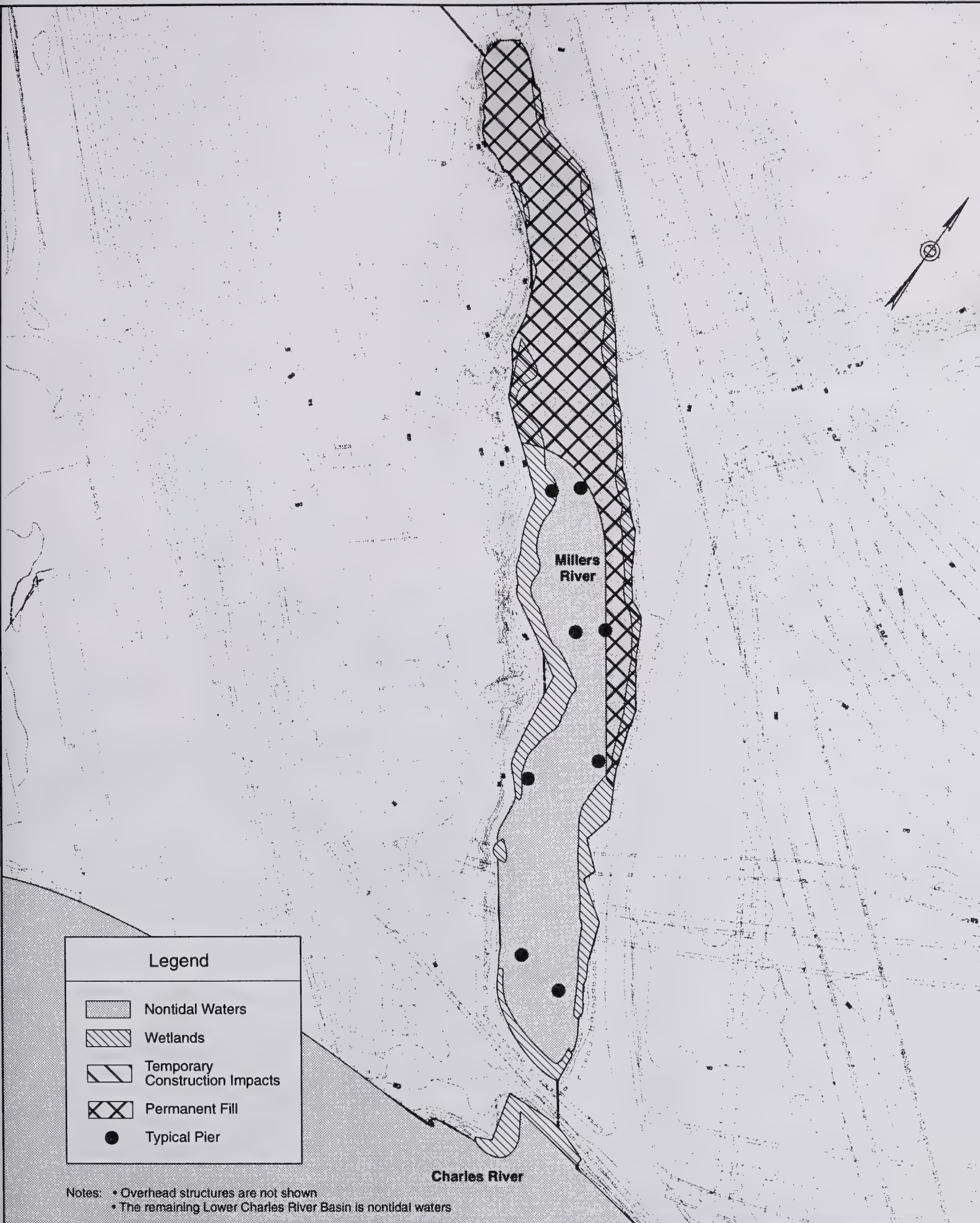
4.35

**Affected Aquatic Resource Areas;
Charles River:
Reduced River-Tunnel Alternative**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 100 200 300 400 FEET





FIGURE

4.36

**Affected Federal Aquatic
Resource Areas; Millers River :
Non-River-Tunnel Alternative**
Charles River Crossing DSEIS/R

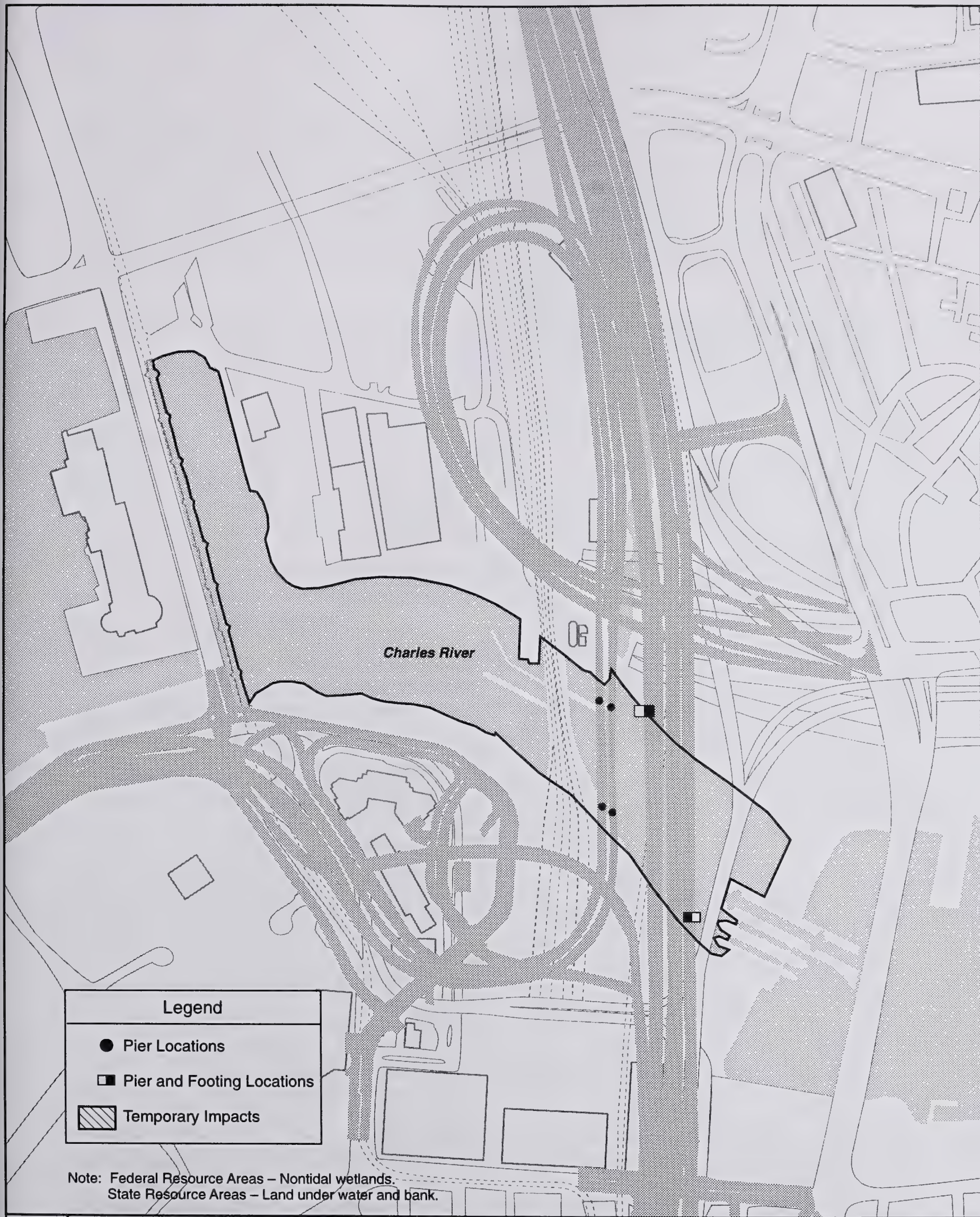


FIGURE
4.37

**Affected Aquatic Resource Areas;
Charles River:
Non-River-Tunnel Alternative**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material." A Section 404 permit cannot be issued by USACE unless it is determined that the proposed activities comply with these guidelines. The Guidelines prohibit discharges of dredged or fill material into Federally-regulated waters and wetlands where practicable alternatives exist which have less adverse impact on the aquatic ecosystem and which do not have other significant adverse environmental consequences. Accordingly, the USACE will evaluate the alternatives with respect to their impacts on the aquatic ecosystem. Such impacts are described briefly below. For the complete analysis, see Appendix C.

Effects On Aquatic Ecosystem Characteristics. The Guidelines require an analysis of the potential short-term and long-term effects of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic ecosystem as described in Subparts C through F of the Guidelines.

These components include the following characteristics of the aquatic ecosystem:

- (1) Physical and Chemical Characteristics (Subpart C)
 - substrate
 - suspended particulates/turbidity
 - water
 - current patterns and water circulation
 - normal water fluctuations
 - salinity gradients
- (2) Biological Characteristics (Subpart D)
 - threatened and endangered species
 - fish, crustaceans, mollusks, and other aquatic organisms in the food web
 - other wildlife
- (3) Special Aquatic Sites (Subpart E)
 - sanctuaries and refuges
 - wetlands
 - mudflats
 - vegetated shallows
 - coral reefs
 - riffle and pool complexes
- (4) Human Use Characteristics (Subpart F)
 - municipal and private water supplies
 - recreational and commercial fisheries
 - water-related recreation
 - aesthetics
 - parks, national and historic monuments, national seashores, wilderness areas, research sites, and similar preserves

The potential effects, both permanent and temporary, on each of the aquatic ecosystem characteristics resulting from Scheme Z and the three new design alternatives is detailed in Appendix C. That analysis found that some characteristics were not present in the affected area of the Charles River or the Millers River. The Charles River and the Millers River are fresh water systems which, in the affected area, do not have salinity gradients, mud flats, any sanctuaries or refuges, coral reefs, vegetated shallows,

municipal or private water supplies, or national or historic preserves. Nor do the areas provide habitat for threatened or endangered species. The disposal of dredged material from the entire Central Artery/Tunnel Project at the Massachusetts Bay Disposal Site (MBDS) was the subject of a biological opinion by the National Marine Fisheries Service (NMFS) in 1991. NMFS concluded that disposal would not jeopardize the continued existence of any threatened or endangered species under NMFS jurisdiction.

The remaining characteristics are affected to some degree by Scheme Z or one of the new design alternatives: Scheme Z with its two bridges has a total (short and long-term) effect on approximately 0.75 acres of waters of the United States. This results in potential effects on suspended particulates/turbidity, water, current patterns and water circulation, normal water fluctuations, fish and other aquatic organisms in the food web, wildlife, and recreational and commercial fisheries. The bridges also shade the Charles River and the Millers River which could result in additional wetlands losses. Scheme Z, due to its larger bridges and loop ramps on the north side of the river has greater potential long-term aesthetic effects on parklands and open space than the three new design alternatives (see Sections 4.22, 4.9 and the Section 4(f) Evaluation).

Alternative 8.1D Mod 5 with its one bridge, fill for access ramps and tunnel under the river affects approximately 3 acres of waters of the United States. More than half of the area affected by activity relates to the construction of a tunnel under the river including: dismantling of the existing seawall, installation of circular cells, and restoration of the seawall as part of the casting basin construction; dismantling and reconstruction of the seawall on the north and south sides of the river for the tunnel approaches; dredging and installation of the sheetpile earth containment system, and installation of tunnel sections. This results in impacts of greater areal extent and longer duration than Scheme Z, and the attendant potential short-term effects on substrate, suspended particulates/turbidity, water current patterns and water circulation, normal water fluctuations, fish and other aquatic organisms in the food web, wildlife, wetlands, recreational and commercial fisheries, water-related recreation, aesthetics, and parklands. The shading of the Charles River and the Millers River by the bridge could result in additional wetlands losses.

The Reduced River-Tunnel Alternative with its one bridge, fill for access ramps and a tunnel under the river affects approximately 2.8 acres of water of the United States. More than half of this area is affected by activities associated with tunnel construction similar to Alternative 8.1D Mod 5. This alternative also could result in additional wetlands losses due to shading by the bridge.

The Non-River-Tunnel Alternative has two bridges and fill for access ramps which affect approximately 1.5 acres of water of the United States. The bridges also shade the Charles River and the Millers River which could result in additional wetland losses.

Summary: Scheme Z and the three new design alternatives have minimal long-term impacts to Federal aquatic resources in the Charles River. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative have greater short-term impacts on Federal resources and on the Charles River due to tunnel construction. The three new design alternatives all result in the fill of 1.1 acres of nontidal waters and 0.20 acres of wetlands in the Millers River. However, these activities will have an insignificant impact to the Principal Valuable Functions of the Charles River and the Millers River.

4.5.1(c) State Wetlands

Affected Environment. The State inland wetland resource areas located in and adjacent to the Charles River and the Millers River include: banks; bordering vegetated wetlands; land under water; and land subject to flooding (See Figure 4.38). The Charles River also contains an anadromous fish run (a coastal wetland resource area).



FIGURE

4.38

State Wetlands Areas

Charles River Crossing DSEIS/R

Methodology. The State wetlands resource areas are delineated in accordance with the definitions as outlined in 310 CMR 10.00 and, except for Bordering Vegetated Wetlands (BVW), as described above according to elevation (see Appendix D). There are very little BVWs surrounding the Millers River. Three small, isolated areas of BVW are located on the west side and southern tip of the Millers River. These areas were delineated as BVW because they contain over 50 percent wetland vegetation, are low and flat, and have annually saturated soils. The wetland vegetation is dominated by reed grass. Interdispersion is low, which is typical of disturbed situations. No BVW are found along the Charles River. In both rivers, the top of the bank (el. 103.5 mean annual flood level) is less than midway up the steep slopes of the rivers and Bordering Land Subject to Flooding (BLSF) occurs as a narrow band between elevation 103.5 and 104.3, or 0.8 foot.

Presumptions Of Significance.

Bordering Vegetated Wetland: BVWs are likely to be significant to public or private water supply, groundwater supply, flood control, storm damage prevention, prevention of pollution, and protection of fisheries and wildlife habitat. In the case of the Millers River BVW, the presumptions of significance apply only for the prevention of pollution.

Banks: Banks are presumed to be significant to public or private water supply, to groundwater supply, to flood control, to storm damage prevention, to the prevention of pollution, and to the protection of fisheries and wildlife habitat. The banks in the Millers River are significant to the prevention of pollution only. Banks in the Charles River are significant to the prevention of pollution and to the protection of fisheries habitat.

Land Under Water Bodies And Waterways: Land Under Water Bodies and Waterways (LUW) is likely to be significant to public and private water supply, to groundwater supply, to flood control, to storm damage prevention, to prevention of pollution, and to protection of fisheries and wildlife habitat. LUW in the Millers River is significant to the prevention of pollution only. LUW in the Charles River is significant to the prevention of pollution and to the protection of fisheries habitat.

Bordering Land Subject To Flooding: BLSF is likely to be significant to flood control and storm damage prevention; however, because the water levels in the Charles River and the Millers River are controlled by the existing MDC dam, the water bodies have no function in terms of providing natural flood control. Because the Charles River is confined by vertical seawalls in this area and surrounding terrain is low and flat, there is no BLSF resource (see Appendix D). Although the Millers River has a constricted outlet and can store stormwaters, the presence of the Charles River dam and basin overrides any flood storage/storm damage protection functional value in the Millers River.

Impacts. The impacts to each wetlands resource area by alternative are shown in Table XXX and described as follows:

Banks: In the Charles River, the alternatives result in minor alterations to the bank from the bridge piers. Scheme Z affects 40 linear feet of bank in the Millers River as a result of pier placement. The three design alternatives result in a permanent loss of approximately 1,200 lf of bank because of fill in and along the Millers River for access ramps.

BVW: There is no permanent impact.

LUW: Impacts to LUW are associated with pier placement.

Scheme Z (see Figures 4.31 and 4.39) places piers in the Charles River resulting in a loss of 0.10 acre of resource area. The placement of piers and fill in the Millers River results in the displacement of 0.01 acres of land under waterbody.

Alternative 8.1D Mod 5 (see Figures 4.33 and 4.40) places piers in the Charles River, resulting in a loss of 0.01 acre of resource area. The placement of piers and fill for access ramps in the Millers River results in the displacement of 1.1 acres of land under waterbody (see Figure 4.40). This alternative will result in the construction of a subaqueous tunnel below the mudline of the Charles River (see Section 5.10.1).

The Reduced River-Tunnel Alternative (see Figure 4.35 and 4.41) places piers in the Charles River, which displaces 0.01 acre of land under waterbody. This design also involves the placement of piers and fill for access ramps in the Millers River, resulting in the displacement of 1.1 acres of resources area (see Figure 4.41). This alternative will result in the construction of a subaqueous tunnel below the mudline of the Charles River (see Section 5.10.1).

The Non-River-Tunnel Alternative (see Figures 4.37 and 4.42) involves the placement of piers in the Charles River resulting in the displacement of 0.02 acre of land under waterbody. This alternative also places piers and fill for access ramps in the Millers River which results in the displacement of 1.1 acres of land under waterbody (see Figure 4.42).

No adverse impact to anadromous fish in the Charles River is expected as measures can be implemented to avoid impact on their spawning run. Scheme Z and the three new design alternatives will remove the existing I-93 piers (except for Pier "A" the reverse banana pier) which currently occupy 0.06 acres of nontidal waters.

BLSF: BLSF in the Charles and Millers Rivers is not significant to flood storage/storm damage protection; thus, any impact in this resource area has no measurable impact. Calculations were performed to determine the area of impact to BLSF in the Millers River (see Table 4.40).

Conformance With Performance Standards. The Certificate issued by the Secretary of environmental Affairs on the 1990 DSEIS/R concludes that the three crossings¹ proposed by the Central Artery Project are water-dependent. This conclusion has a bearing on the application of performance standards in inland wetland regulations. All portions of the Project which affect wetland resource areas are water-dependent.

Section 10.53(3)(l) establishes water-dependent uses as limited projects in inland wetlands. The performance standards for each resource area, therefore, do not apply except as follows: any portion of such work which alters a BVW must comply with the governing regulations; if any other resource area is found to be significant to flood control or prevention of storm damage, the performance standards must be met for those interests; and finally, adverse impacts from such work in any other resource area shall be minimized in relation to the statutory interests for which that resource area is found to be significant.

BVW: The Performance Standards for BVW apply only to the interest of prevention of pollution as discussed in Appendix D. No BVW is lost.

LUW: The Performance standards do not apply; nevertheless, in all alternatives except for Scheme Z, the areal extent of this resource area will increase as a result of removing the existing I-93 piers. The

¹ Harbor Tunnel, Fort Point Channel and Charles/Millers Rivers



FIGURE

4.39

**Affected State Wetlands Areas;
Millers River :
Scheme Z**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 400 800 1600 2400 FEET





FIGURE

4.40

Affected State Wetlands Areas; Millers River: Alternative 8.1D Mod 5 Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
 CENTRAL ARTERY/TUNNEL PROJECT

0 400 800 1600 2400 FEET





FIGURE 4.41

**Affected State Wetlands Areas;
Millers River:
Reduced River-Tunnel Alternative**

Charles River Crossing DSEIS/R





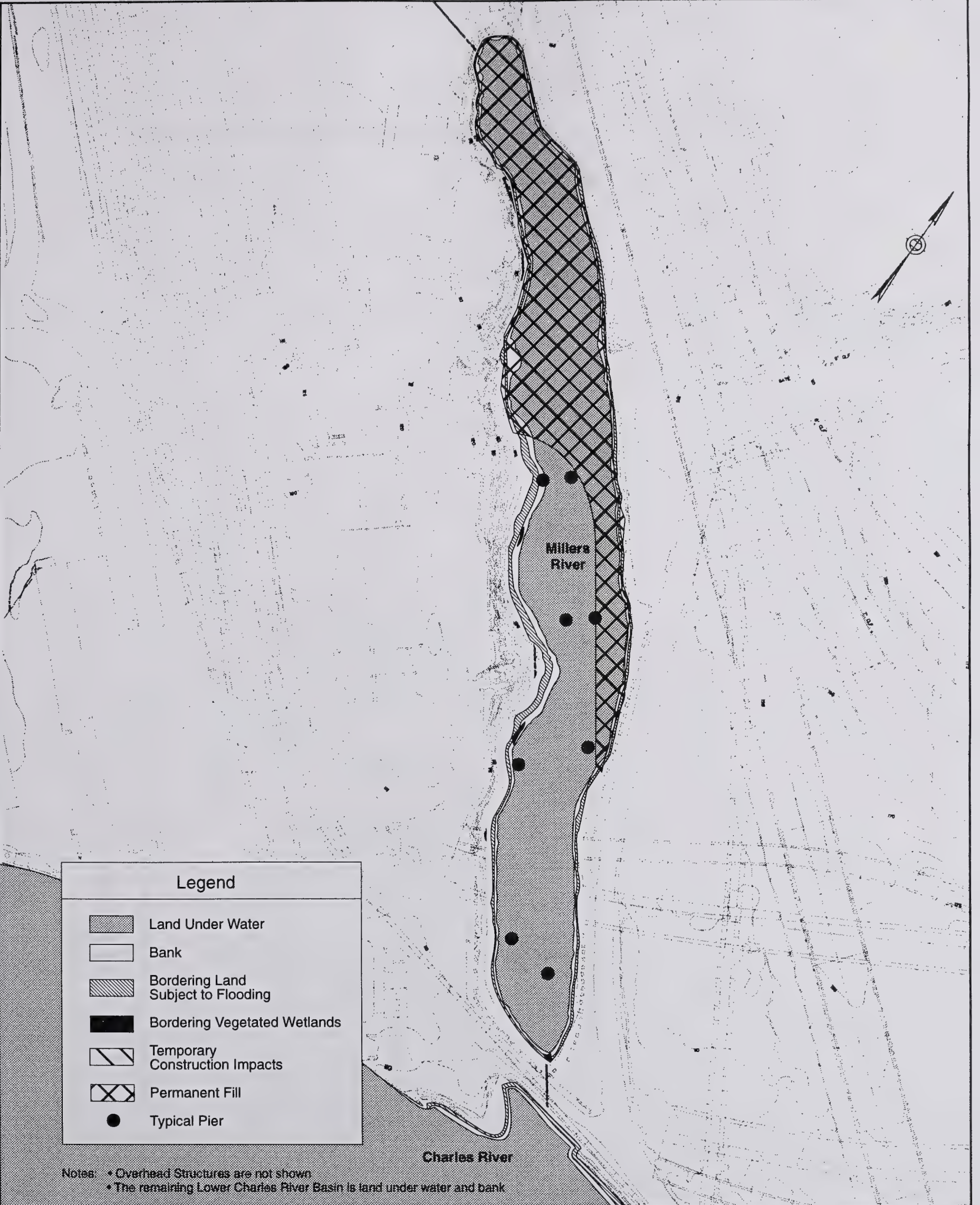


Table 4.40

PERMANENT IMPACTS TO STATE WETLAND RESOURCE AREAS

	Scheme Z ²	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River Tunnel
Charles River				
bordering vegetated wetland (acres)	N/A	N/A	N/A	N/A
banks (linear feet)	10	0	20	20
land under water (acres)	0.10	0.010	0.010	0.02
land subject to flooding (acres) ¹	N/A	N/A	N/A	N/A
Millers River				
bordering vegetated wetland (acres)	0	0	0	0
banks (linear feet)	40	1,200	1,220	1,200
land under water (acres)	0.01	1.1	1.1	1.1
land subject to flooding (acres)	0.01	0.05	0.05	0.05

¹ Presumptions of significance for this do not apply.

² The impacts have been recalculated to reflect current pier dimension and construction methods, thus differing from those identified in the 1991 FSEIS/R.

significance of this resource area for flood control or prevention of storm damage has been rebutted; therefore, the performance standards do not apply (see Appendix D).

Banks: The Performance Standards do not apply. The significance of this resource area for flood control or prevention of storm damage has been rebutted; therefore, the performance standards do not apply (see Appendix D).

BLSF: The significance of this resource area for flood control or prevention of storm damage has been rebutted; therefore, the performance standards do not apply (see Appendix D). Nevertheless, the proposed placement of piers in the Charles River or fill in the Millers River will not restrict flows in a manner which will increase flood stage or velocity. The existing banana pier will remain in the Charles River to retain its hydrodynamic function in regard to the MDC dam turbine system. In addition, in all alternatives except for Scheme Z, the flood storage capacity in the Charles River will increase as a result of removing the existing I-93 piers.

Summary. Scheme Z and the three new design alternatives affect State wetlands. Scheme Z affects 50 linear feet of bank and 0.10 acre of LUW. All three new design alternatives similarly affect the Millers River, resulting in permanent disturbance of 1,200 lf of bank and approximately 1 acre of LUW. Because the project is water-dependent, the regulations only require impacts be minimized.

4.5.2 Waterways

This section describes the impacts of Scheme Z and the alternatives on waterways in the study area. A summary of permanent impacts to filled and flowed waterway resources is shown in Table 4.41.

4.5.2(a) Jurisdiction

State waterways resources are defined by the Massachusetts Waterways Act and Implementing Regulations (MGL c. 91 and 310 CMR 9.00), and are characterized as either flowed or filled tidelands. Flowed tidelands include all submerged lands lying below the ordinary high water mark of the Charles and Millers Rivers, and below the Charles River dam in tidal waters the jurisdiction extends below the mean high water (el. 104.5). Filled tidelands include areas below the historic or natural shoreline except for "landlocked" tidelands. Landlocked tidelands are filled tidelands separated from the water by a public way, provided that the tidelands are at least 250 feet away from the water and are not located within a designated port area. The State waterways interests include fishing, fowling, navigation, the protection of water-dependent uses, and overall public benefit. Navigation requirements of Federal and State regulations are discussed in Section 4.5.3. The following subsections address State waterways interest, and may be applied to Federal waterways public interest.

4.5.2(b) Affected Environment

The State's Chapter 91 jurisdiction within the study area is the same as the 1991 FSEIS/R, and includes the flowed portions of the Charles River and the Millers River and filled tidelands, as shown in Figure 4.43.

Finding Of Water Dependency. The Secretary of Environmental Affairs determined in the Certificate on the Draft SEIR (August 29, 1990) that the Charles River crossing, including its ancillary facilities, is a water-dependent infrastructure crossing within the meaning of the applicable Chapter 91 regulations.

The basic transportation requirement for the Area North of Causeway Street Project subarea is to include connections from I-93 north and south of the Charles River, and Route 1 "Storrow Drive" and Route 1 "Tobin Bridge", also north and south of the river, and all necessary local connections to those facilities.

The elements of the Charles River crossing have been placed in their various locations for transportation planning, engineering, design, and environmental reasons, and cannot reasonably be located outside of tidelands. Also, ramp alignments must satisfy specific design criteria which stipulate curve radii, tangent length, weave distance, minimum sight lines, and other geometric requirements which significantly limit the ability to realign or relocate ramps and approaches outside tidelands in this vicinity.

All of the alternatives considered in this DSEIS/R constitute a public infrastructure crossing of the Charles River. The three new Charles River crossing design alternatives also incorporate a public infrastructure crossing of the Millers River as part of the Charles River public infrastructure crossing in order to achieve required traffic movements and design criteria. The Charles River crossing alternatives and their on-land and underwater tunnels, ramps, surface roads, utilities and ventilation building(s) are water-dependent public infrastructure crossings.

Existing Waterways Functions. Waterways resources within the Project areas were evaluated to establish their current functional value. The interests of navigation, public access waterside (flowed tidelands) and landside (filled tidelands), public/social benefit, and the water-dependent uses were evaluated.

Charles River. Presently, the Charles River functions well for the waterways interest of navigation. For navigation interests, the Lower Charles River Basin does not have a defined channel. The upstream limit of the USACE Federal navigation project for the Charles River is the Charlestown bridge which is downstream of the Project limits. Historic State harbor lines exist in the area, but have little relation to current navigation, because of the filling and bridge and dam construction which has taken place over the years (see Section 4.5.3). Legislation addressing project compliance with existing Harbor Lines will be pursued.

The area presently has no public waterside access, however, and limited landside access via sidewalks along the waterfront. The area does provide public benefit (i.e., flood control), and there are limited water-dependent uses. Current land uses at the water's edge are primarily rail transportation, industrial, institutional (hospital and jail), and open space. There are two active water-dependent uses, the MDC Gridley Dam and Locks, and the MDC Harbor Police. In addition, there are approximately 7,700 linear feet (lf) of waterfront along the Charles River. Approximately 2,500 lf of waterfront contains existing sidewalks or walkways which are open to the public (see Figure 4.43). There are also structures which cross the river and provide an approximate total of 2,400 lf of water frontage, of which approximately 1,240 lf contain walkways that are open to the public.

There also is access from Causeway Street east of the Boston Garden north towards the river. Implementation of the 1993 CANA temporary loop ramp permits will result in improvements to a portion of the Paul Revere Landing Park North and will create a walkway connection from Rutherford Avenue and City Square to the Charles River via this park. These improvements will provide an enhanced park and public access along the Charles River.

Millers River. The Millers River presently has a low functional value for all waterways interests. All functions are rated low as the river is non-navigable (see Section 4.5.3), has no waterside public access, has limited landside public access, provides minimal public benefit and contains no water-dependent uses. Of the approximately 2,200 lf of waterfront on the Millers River, there is no improved public access.

4.5.2(c) Long-Range Impacts And Conformance With Performance Standards

Because the Charles River crossing is a water-dependent public infrastructure crossing, it is presumed to serve a proper public purpose which provides greater benefit than detriment to the rights of the public

STATE WATERWAYS PERMANENT IMPACTS

(acres)

Alternative	Activities	Flowed Tidelands ^a	Filled Tidelands ^a
Millers River			
Scheme Z	Highway structures ^b	1.1 _c	12.8
	Retaining wall	0.00	0.004
	Total	1.1	12.8
8.1D Mod 5	Highway structures	1.7 _d	12.4
	Total	1.7	12.4
Reduced River-Tunnel	Ventilation building	0.00	0.2
	Highway structures	1.6 _e	14.2
	Total	1.6	14.4
Non-River-Tunnel	Highway structures	1.8 _f	14.2
	Total	1.8	14.2
Charles River			
Scheme Z	Highway structures	2.6	5.5
	Piers (in water)	0.10	0.00
	Total	2.7	5.5
8.1D Mod 5	Highway structures	3.1	10.1
	Piers (in water)	0.009	0.00
	Total	3.1	10.6
Reduced River-Tunnel	Highway structures	3.2	10.4
	Piers (in water)	0.012	0.00
	Total	3.2	10.6
Non-River-Tunnel	Highway structures	2.8	13.1
	Piers (in water)	0.014	0.0
	Total	2.8	13.3

^a Includes structures on or above tidelands, such as tunnels or bridges.

^b Highway structures include footprint of tunnels, surface roads, ramps, and viaducts.

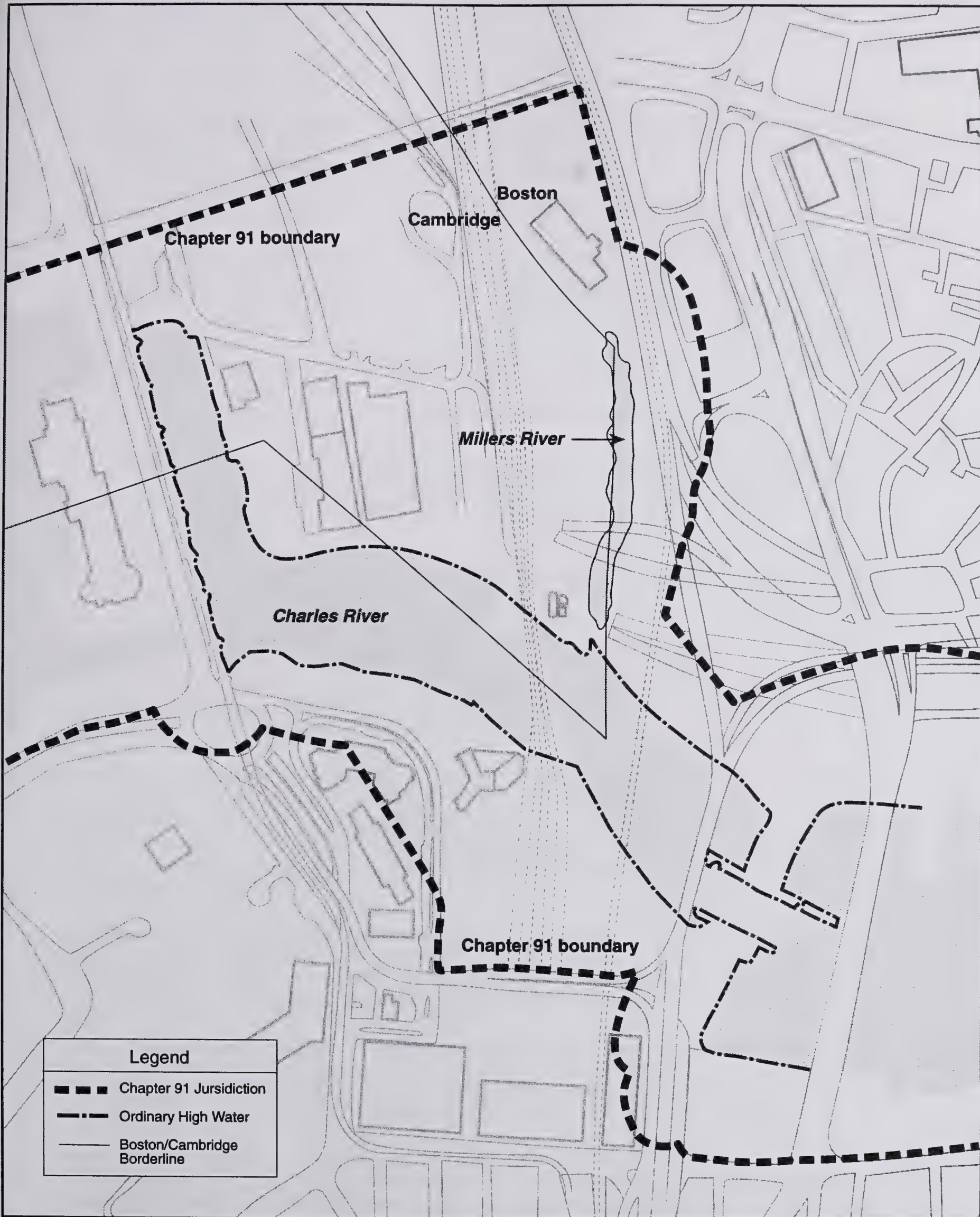
^c Includes 0.0 acre piers.

^d Includes 1 acre of fill and 0.013 acre of piers.

^e Includes 1 acre of fill and 0.015 acre of piers.

^f Includes 1 acre of fill and 0.014 acre of piers.

^g Below grade.



FIGURE

4.43

State Waterways Jurisdiction Charles And Millers Rivers Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



in tidelands. In addition, the Special Procedures adopted by DEP on May 16, 1991, for licensing the Project state that, "...the CA/T project has been determined to merit special consideration for expedited review because there is a significant public benefit associated with the project."

The Project meets the performance standards outlined in CMR 9.31 through 9.40, as discussed below.

Long-Range Impacts. Project activities result in permanent impacts to flowed and filled tidelands, due to the installation of bridges, piers, viaducts, boat sections, surface roads, land tunnels, in-water tunnels, ventilation buildings, new utilities, and utilities relocations (see Appendix D for details). Some of the impacts are common to all of the alternatives analyzed and some are unique to the specific alternative (see Table 4.41). Activities in flowed tidelands result in limited permanent effects to navigation (see Section 4.5.3) and all alternatives require the construction of ventilation buildings on filled tidelands. The visual effects of these ventilation buildings are described in Section 4.2.5. Finally, all alternatives place approximately 1.1 acres of fill in the Millers River for access ramps and a signalized intersection.

Water-Dependent Uses: Scheme Z and the three new design alternatives result in no permanent impacts to water-dependent uses. The proposed bridge superstructure has minor effects on the view corridor of the operators of the MDC Gridley Dam and Locks, but only in locations which are presently outside of the "navigation channel."

Visual Effects: Under all alternatives, the bridge designs substantially reduce the number of piers in the Charles River and the Millers River from those described in the 1991 FSEIS/R. The fewer piers, coupled with the removal of the existing I-93 piers and a more aesthetically pleasing bridge design, improve pedestrian shoreline views to and along the existing and future waterfront walkways and parklands. Existing visual obstructions are alleviated by removal of the existing I-93 bridge piers. The dam operators' views to the bascule bridge and to the entire width and breadth of the navigation channel are improved by removing the existing I-93 bridge piers. The pier removal also increases the area and volume of the flowed portion of the Charles River.

Public Access: Impacts to filled tidelands temporarily affect existing substandard public access; however, all alternatives increase and improve public access in the area. Unlike Scheme Z, the three new design alternatives remove the existing CANA ramp stubs along the north bank of the Charles River and relocate the Central Artery-to-local Ramp C-L and Central Artery-to-Tobin Bridge Ramp C-T into tunnels or ramps farther away from the shoreline, thereby further improving public access and open space opportunities along the river.

Conformance With Waterways Performance Standards. The major components of the Project are reviewed below to demonstrate compliance with the applicable Chapter 91 performance standards. All of these activities occur on land currently in nonwater-dependent use or on vacant land; therefore, the Project will result in a net increase in water-dependent uses in this area.

Categorical Restrictions On Fill And Structures: In Scheme Z and the three new design alternatives, the Charles River crossing requires the placement of bridge piers in the Charles River and bridge and ramp piers in the Millers Rivers (see Table 4.41). As pier-supported structures for water-dependent uses, the proposed bridges comply with the categorical restrictions outlined in 310 CMR 9.32 (1)(a)(2).

Unlike Scheme Z, the three new design alternatives result in the placement of approximately 1.1 acre of fill in the Millers River for access ramps to and from the crossings (see Table 4.41). However, the amount of fill is minimized and its placement cannot reasonably be located upland pursuant to 310 CMR 9.32 (1)(a)(2). Alternative 8.1D Mod 5 results in two additional tunnels under the southern portion of

the Millers River, and the Reduced River-Tunnel Alternative also results in two tunnels under the Millers River, one along the southern end of the river and the other through its midsection. For both designs, the tunnels are placed below the mudline.

Environmental Protection Standards: Scheme Z and the three new design alternatives comply with the approved MCZM Program and the design will be implemented in a manner consistent with that program. A statement regarding the consistency of the Project is included in Appendix E of this DSEIS/R. Prior to the issuance of an individual license for the activities described herein, the MHD will comply with the provisions of the Massachusetts Environmental Policy Act; obtain required approvals under the Wetlands Protection Act; and obtain a Water Quality Certification for activities as required in this area.

Conformance With Municipal Zoning And Harbor Plans: The Cambridge Zoning Laws and the Boston Zoning Code are not applicable to the Project, a State highway project. The City of Cambridge does not have an approved Municipal Harbor Plan. The Secretary of Environmental Affairs approved the City of Boston Municipal Harbor Plan on May 22, 1991. The plan covers Boston Harbor proper; thus, the Project alignment is outside the plan boundaries. In the approval, the Secretary found that the Municipal Harbor Plan does not apply "to any State project or portion thereof that is exempt from zoning requirements by law." The Project, as a State highway project, is exempt from compliance with local zoning by-laws and, therefore, the approved Municipal Harbor Plan does not apply to this project.

Standards To Preserve Water Related Public Rights: While Project activities will occur in both filled and flowed tidelands, neither Scheme Z nor the three new design alternatives significantly impair the rights held by the Commonwealth in trust for the public to use tidelands for public purposes, which include water-related rights and interests in fishing, fowling, navigation, and public access.

Public Rights Applicable To All Waterways.

Navigation: Under Scheme Z and the three new design alternatives, there will be temporary impacts on navigation due to construction activities, but the permanent impacts of the Project on navigation are expected to be minimal. No piers will be placed in the "navigation channel." The proposed bridges will have a minimum vertical clearance of 23 feet above recreation locks and 30 feet above the commercial lock, which maintains existing minimum clearances in the river. Shading impacts on the boaters is expected to be a minor factor in navigation as vessels in this area generally are moving at a slow speed or queuing to wait for the bascule bridge or the locks to open. The alternatives place permanent piers in the river, outside the navigation channel.

These impacts will be offset through the removal of existing I-93 bridge piers and, unlike Scheme Z, the alternatives result in a net removal of fill from the flowed portion of the Charles River. Hence, no significant interference with public rights of navigation will occur. Bridge and ramp piers as well as fill will be placed in the Millers River. The Millers River is non-navigable; therefore, these activities will not adversely affect the navigational interests in these areas (see Table 4.41 and Section 4.5.3, Navigation).

Free Passage Over And Through Water: The alternatives will not preclude free passage over and through the Charles River. Passage over and through the Millers River is presently precluded.

Access To Town Landings: There are no known town landings within the Project area and, thus, this standard does not apply.

Public Rights Applicable To Tidelands.

Fishing And Fowling: Neither Scheme Z nor the three new design alternatives significantly interferes with the public rights of fishing and fowling, and all will improve public access. The performance standards are met as the Project will not pose any substantial obstacle to the public's ability to fish or fowl in the waterway areas adjacent to the Project site; and the Project will not result in the elimination of traditional fishing or fowling locations used extensively by the public.

On-Foot Passage: The alternatives do not significantly interfere with the public rights to walk or otherwise pass freely on private tidelands or Commonwealth tidelands. The Project is a water-dependent use on filled Commonwealth tidelands and thus, the standard requires the provision of public passage by such means as are consistent with the need to avoid undue interference with the water-dependent uses in question. Public access along the banks of the Charles River, which is currently restricted by the presence of highways, railroad tracks and other institutional uses, will be increased and improved.

Disruption to existing pedestrian use within the entire area of Chapter 91 jurisdiction is minimal because current pedestrian use is low to nonexistent. Consequently, the net effect of Scheme Z and the three new design alternatives is one of opening up the area to pedestrian use. Section 4.2.2 which describes the open space and parklands impacts and the Section 4(f) Evaluation demonstrate that the proposed improvements outweigh any adverse impacts.

The alternatives will result in a substantial increase in area devoted to water-dependent uses and provide reasonable measures for on-foot passage along and to portions of the north and south banks of the Charles River. No access is proposed along the Millers River.

Compensation For Interference With Public Rights In Commonwealth Tidelands. The alternatives do not propose any private use of Commonwealth tidelands and thus, this standard does not apply.

Management Of Areas Accessible To The Public. The long-term management of public facilities including walkways and open space located on tideland areas will be identified during the licensing process for this area.

Standards To Protect Water-Dependent Uses. The only active water-dependent uses on the Charles River within the Project area are the MDC Gridley Dam and Lock, the Spaulding Rehabilitation Hospital pier, the MDC Harbor Patrol, the existing railroad and I-93 bridges, and the various walkways. The Project design preserves the availability and suitability of these waterways as they are presently used by the existing water-dependent uses. The Charles River crossing designs have minimal impacts on navigation and will not impede the right of access by water to adjacent property owners' land.

Scheme Z and the three new design alternatives will result in increasing the number of water-dependent uses and improving benefits to the public in and along the Charles and Millers Rivers. Another beneficial impact of the new alternatives is that all aid implementation of portions of the MDC parkland master plan proposals for the lower Charles River Basin. Without the Project, the achievement of open space improvements and functional pedestrian linkages would occur haphazardly, being constrained by public funding and by conflicting private interests.

Private Access To Littoral Or Riparian Property: None of the bridge piers proposed in the Charles River affects private access to riparian property. In the Millers River, access from the water is not presently available and private access to the water is not precluded. None of the alternatives interferes with littoral or riparian property owners' rights to approach their property from the Charles River or to approach the Charles River from their property.

Disruption Of Water-Dependent Use: The alternatives may have a minor effect on the MDC Gridley Dam and locks operators' view corridor, and this will be evaluated in more detail in subsequent bridge design review.

Displacement Of Water-Dependent Use: There are no existing water-dependent uses in the Project area that will be displaced by the Project, except the existing I-93 bridge which will be removed and replaced by a new bridge. The nearest water-dependent uses are the MDC Gridley Dam and Locks, the railroad bridge, the Spaulding Rehabilitation Hospital pier, and the MDC Harbor Patrol.

Fill Or Structures Which Preempt Water-Dependent Industrial Use Within A Designated Port Area: The Project area is not in a designated port area and thus this standard does not apply.

Engineering And Construction Standards. The Project is being designed and will be constructed in accordance with accepted engineering and construction standards.

Use Standards For Recreational Boating Facilities. No recreational boating facilities are affected or being proposed; therefore, this standard does not apply.

Standards For Marinas, Boatyards And Boat Ramps. No marinas, boatyards or boat ramps are being proposed; thus this standard does not apply.

Standards For Dredging And Dredged Material Disposal. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative require dredging for the placement of subaqueous tunnels. In addition, limited additional dredging occurs for the placement of bridge piers. These impacts are temporary (see Section 5.2) and will meet the waterways standards.

4.5.2(d) Proposed Mitigation Measures

Summary Of Project Impacts. The alternatives minimally alter or remove some existing waterways resources, including filled and flowed tidelands. However, MHD will provide mitigation for impacts and, compared to existing conditions, will improve the waterways functions within the Project alignment in the Area North of Causeway. The Charles River crossing, in conjunction with other aspects of the overall Project, will also substantially improve highway access to the maritime industrial Port of Boston.

The analysis of impacts and conformance with performance standards demonstrates that the Charles River crossing has no adverse long-term effect on the interests of fishing and fowling and thus, no mitigation for these interests is required. Finally, under all alternatives, on-foot passage within the project area is greatly enhanced over existing conditions, and public access improvements will be made.

All Project activities within Chapter 91 jurisdiction, regardless of alternative, are water-dependent. A large portion of these facilities are underground structures which will have minimal impact on the public interest in filled tidelands.

CANA Mitigation. The 1991 FSEIS/R includes specific mitigation measures designed to offset the improvements required under the separate but related CANA project. The CANA project has been partially completed under the CANA Chapter 91 license, issued in 1987. The balance of the project has been redesigned and will be integrated into the Central Artery/Tunnel project. Portions of the existing CANA project will be removed under the three new design alternatives. The CANA project as originally licensed will not be constructed, and the original CANA mitigation measures are no longer applicable. Appropriate waterways mitigation will be provided as part of the Revised Charles River crossing project, as described below.

Revised Charles River Crossing Mitigation. Mitigation is required for those permanent impacts which adversely affect the public interests in tidelands including navigation, fishing and fowling, and the provision of on-foot passage where feasible. Mitigation measures for navigation include the provision of fendering systems and maintaining the view corridor of the MDC Gridley Dam and Locks operators. The regulations also require the provision of on-foot passage along or to the shoreline within or from the Charles River crossing. On-foot passage will be provided along the north and south sides of the Charles River which is at least as equivalent to the total linear footage of shoreline occupied by crossing structures.

All the alternatives will result in extensive mitigation along the Charles River. On the north bank of the Charles River, a total of approximately 1,000 lf of public access area will be provided extending west of the Paul Revere Landing Park North, including a pedestrian bridge over the railroad tracks. In addition, a 1,200 lf walkway will be provided from Rutherford Avenue to the Charles River via the land west of the Millers River.

Public access will be provided on the south side of the Charles River on approximately 500 linear feet of public access along Lovejoy Wharf, and 400 linear feet from Causeway Street to Lovejoy Wharf. Although not proposed as Chapter 91 mitigation, extensive parkland and pedestrian access and open space improvements will be provided along the Charles River in this area as described in the Section 4(f) Evaluation.

4.5.2(e) Summary

The two types of State waterways resource areas that will be permanently affected by the three new alternatives and the 1991 Proposed Action (Scheme Z) are flowed tidelands (i.e., the Charles and Millers Rivers) and filled tidelands (i.e., formerly flowed tidelands). The three new design alternatives result in fewer impacts than Scheme Z on both banks of the Charles River due to the inclusion of land-based tunnels between Storrow Drive and the Central Artery, which maximizes waterways interests of public access and visual quality. Some of the additional benefits of the three alternatives over Scheme Z will be a reduction in the amount of viaducts and piers, improving navigational interests of the Charles River and improving the visual environment in all of the planned riverfront parkland areas. The three new design alternatives place structures within 100 feet of the Charles and Millers Rivers. Substantial new public access (on-foot passage) will be provided along and to the north and south banks of the Charles River.

4.5.3 Navigation

No permanent impacts to navigation in the Charles River are expected from Scheme Z and the three new design alternatives. The subsequent preliminary and final design processes for the selected alternative will address the proximity of bridge piers and any river tunnel alignment to the navigational area and to the MBTA Orange Line tunnel which underlies the river-tunnel alignment. The evolving design will be reviewed with the MDC, the U.S. Coast Guard (USCG), USACE, and other agencies concerned with marine safety and navigation. All relevant navigational commitments in the 1991 FSEIS/R will be implemented in any of the alternatives.

4.5.3(a) Impacts Of Structures In The Water

An overview of the permanent navigational impacts of the alternatives in comparison to Scheme Z is provided as follows: (For construction period impacts see Section 5.10.4).

Alternative 8.1D Mod 5. This alternative includes one bridge over and one tunnel under the Charles River. One 15-foot by 25-foot pier is in the water at the north bank of the river. This is a reduction

from the 11-pier design proposed for Scheme Z. Further, the bridge pier proposed in the waterway under this alternative is located outside the area used for navigation. The tunnel is designed to cross the Charles River below the mudline and, therefore, has no permanent impact to navigation.

Reduced River-Tunnel Alternative. This alternative also includes one bridge over and one tunnel under the Charles River. The mainline bridge requires one 20-foot by 25-foot pier at the south bank of the river in the water, and one 20-foot by 25-foot pier partially in the water on the north bank. This is a reduction from the 11-pier design in Scheme Z. The bridge piers are located outside the area used for navigation. The tunnel is designed to cross the Charles River below the mudline.

Non-River-Tunnel Alternative. In this alternative there are two bridges which cross the Charles River. Similar to the mainline bridge in the Reduced River-Tunnel Alternative, this mainline bridge requires one 20-foot by 25-foot pier on the south bank of the river in the water and one 20-foot by 25-foot pier partially in the water on the north bank. The second bridge requires four 8-foot diameter piers in the water near the bascule bridge. All the piers are located behind the current fender pier lines, and outside of the area used for navigation. This is still a substantial reduction from the 11 piers located in the area used for navigation proposed in Scheme Z.

Each of the three new design alternatives for the Charles River crossing results in the reduction in the number of structures in the water and the narrowing of the bridge structure above the water. Accordingly, the long-term impacts of these new design alternatives are beneficial to navigation interests. The permanent impacts upon navigation in shadows, visual obstructions, and wind are discussed below.

4.5.3(b) Other Permanent Impacts

Shadows. A shadow study of Scheme Z and the alternatives shows that there is no deleterious impact resulting from shadow effects of the bridge structure. Shadows were evaluated at various hours of the day and different months of the year. The bridge casts the widest shadows over the river yearly on December 22 at 3 PM, a time of minimal activity in this area. During the season of peak activity along the riverfront on June 22 at noon, depending on which bridge is built, the expanse of shade experienced by waterborne traffic is as follows:

Alternatives	Linear Feet Of Shade (Approx.)
*Scheme Z	340
Alternative 8.1D Mod 5	200
Reduced River-Tunnel Alternative	285
*Non-River-Tunnel Alternative	300

* The linear feet of shade is interrupted due to the presence of space between two bridge structures.

Visual. The visual obstructions cited in the 1991 FSEIS/R for Scheme Z are diminished because of the reduction in the number of piers under the alternatives.

Wind. Navigation in the Charles River is not adversely affected by wind effects of any of the Charles River crossing designs. In assessing potential effects of wind on navigation, the relevant structural dimensions of each design are the width and thickness of the bridge deck, the height above water of the bridge span, and the number, size, and spacing of the bridge piers. Since Scheme Z includes a double-deck bridge and a relatively wide deck for the two mainline bridges, as well as the most piers of all alternatives, this alternative has the most impact on wind and flow disturbance. However, significant flow acceleration under the proposed bridges in any design is not expected, and flow disturbance resulting from bridge piers is localized. Appendix G identifies the basis for this conclusion regarding wind effects on navigation.

Summary. The subsequent design process for the selected alternative will clarify any long-term impacts, if any, to navigation. The design will be reviewed with the relevant regulatory agencies including the MDC, USACE and USCG to identify measures to mitigate any long-term impacts. There are no significant differences with regard to permanent navigational impacts for Scheme Z and the alternatives. For construction period impacts refer to Section 5.10.3.

4.5.4 Fisheries

4.5.4(a) Affected Environment

The Charles River has a warm water fishery and an anadromous fish run. During 1981, the Massachusetts Division of Fish and Wildlife conducted a survey near the Boston University bridge that reported golden shiners, white perch, alewife, pumpkinseed, yellow perch, white sucker, white catfish, northern pike, chain pickerel, and brown bullhead. Fish also common to the basin could include bass, bluegill, crappies, carp, pickerel, and various minnows (Mugford, 1969). American eel and alewife represent fish species which migrate through the Charles River dam. Alewife are the most common among anadromous species (which also include American shad and blueback herring) that migrate to the Charles River to spawn. Eels, conversely, are catadromous: i.e., they migrate to the sea to spawn, the young return to fresh water after their first year of growth.

Species most common to the area of the Charles River Crossing would be those that prefer low flow, deep water pools except during migratory periods when herring are the predominant species. The following sections describe the general condition of fisheries, and the major differences in the permanent impacts of proposed crossing options.

General. The value of the Charles River Basin as a deep water pool fish habitat may be somewhat limited by the high biological and chemical oxygen demands reported for the Charles River in the 1991 FSEIS/R. Reduced oxygen concentrations and soft sediments lower the value of the basin as spawning habitat. This is particularly true for the Millers River that joins the Charles River just above the dam. The Millers River is connected to the Charles River by two 84-inch culverts that are partially filled with sediments. When the Millers River was sampled using electrofishing methods on November 28, 1989, no fish were observed. Sediments sampled for invertebrates further indicated the area was devoid of insect forage for fish. Oxygen concentrations were high enough to sustain fish life only adjacent to the culverts. The Millers River does not provide a fish resource.

Alewife migration from the Boston Harbor estuary into the Charles River is also somewhat impeded by the locks and dam. The fish ladder that was built into the dam's structure to facilitate migration, has become inoperable in recent years. The gating and pumping system, that controls the freshwater flow attracting alewife to the ladder, no longer functions. Also, because the upstream gate no longer opens, fish that enter the passage cannot gain access to the Charles. Consequently, fish that successfully migrate into the Charles River have done so by passing through the locks.

Despite these limitations, this pool of the Charles River Basin provides feeding and spawning habitat for a warm water fishery. In the immediate vicinity of proposed construction much of the shoreline is developed, with vertical concrete and rock walls. Piers of existing bridges and the dam provide structure used for protection and feeding, while shallow areas upriver would provide additional, and better spawning habitat.

Shoreline and channel structures, such as walls and piers, serve as surfaces for algal growth which provides a food resource for many fish species (e.g., golden shiner) and the invertebrate forage (e.g., crustaceans, snails, midge larvae) for other fish (e.g., brown bullhead). Most frequent in the midwaters

of the basin during the summer would be those species that feed on plankton or "hatching" insect larvae (e.g., bluegill, golden shiners). Others common to the deeper water would include those that feed on invertebrates found in the soft sediments, such as the white sucker. In contrast, fish such as pumpkinseed most likely inhabit vegetation in shallows upriver, and only school in the deeper waters near the dam during the winter.

The rock and gravel, and shallow, vegetated areas upriver of the dam provide the better spawning habitat for many of the species listed by the Massachusetts Division of Fish and Wildlife. The shallows provide attachment surfaces for species that lay adhesive eggs (e.g., pumpkinseed, brown bullhead, northern pike) and vegetation that provides larval fish with refuge from predation. Eggs broadcast by some species, such as the yellow perch, are unlikely to develop successfully if spawning occurs in deeper waters adjacent to the dam.

4.5.4(b) Permanent Impacts

There are no permanent adverse impacts to fish habitat in the Charles River under Scheme Z or the alternatives. Since the Millers River does not sustain fish habitat, there are no permanent impacts. In addition, since the new alternatives have fewer piers in the water compared to Scheme Z, the alternatives have reduced impacts (for construction period impacts, refer to Section 5.10.4).

Charles River. The piers placed in the Charles River for crossing designs and the shade beneath them provide structure and cover preferred by many sunfish (e.g., crappies, bluegill). Juvenile American shad have also been observed (personal communication; Boyd Kynard, U.S. Fish and Wildlife Service) to take residence in shadows during their downstream migration in the Connecticut River. Juvenile shad, which tend to move in the afternoon and evening (O'Leary and Kynard, 1986), may inhabit the shady refuge until light intensity lowers later in the day, or during cloud cover. These shad also, unlike the alewife and blueback herring of the Charles River, appear to avoid entering a distinct shadow as adults. Inasmuch as observations about shad responses to shadows have not been scientifically evaluated, similar reactions to shadows have never been reported for the species (i.e., alewife or blueback herring) that migrate into and from the Charles River in the spring and fall, respectively. Alewife and blueback herring move more consistently throughout the day, and exhibit seaward migration in response to decreases in water temperature (O'Leary and Kynard, 1986) and rainfall events (Stokesbury and Dadswell, 1989). There are several additional reasons why, regardless of the species of herring, all bridge alternatives would not affect migratory patterns.

The Charles River has shadows cast upon it by the existing dam, I-93, and the railroad bridge on either side of the bridge crossing in any design. It seems unlikely that shadows added to those already cast on the river pool would have any measurable effect on migratory behavior. And unlike many structures casting shadows on the Charles (e.g., locks and dam), all designs have their components separated to the greatest practical extent; thus allowing sunlight to illuminate waters beneath the crossings. Furthermore, modeling conducted to describe Scheme Z visual impacts (1991 FSEIS/R; Part IIB 1, Section 1.4.9), showed that, during the spring when anadromous herring are migrating to fresh water, the first shadows encountered by fish during most of the day would be formed by sunlight passing through the cables suspending the main bridge structure. The angle of incidence allows cables to serve in defracting the sunlight; thus softening the shadow edge cast upon the water which is first experienced by the fish that pass through the locks and dam. Furthermore, the shadow cast during the fall by all bridge designs provides the shade that is preferred by downstream migratory shad. The shadow created in the afternoon and evening extends to the fishway, and therefore tends to promote migration from the river basin eliminating the transitions from shadows during migration from the basin. The shadows cast by all of the alternatives would less likely affect behavior than those formed by existing structures, even assuming alewife would respond to shadows.

Unlike Scheme Z and the Non-River-Tunnel Alternative, Alternative 8.1D Mod 5 and the River-Tunnel Alternative affect shallow, shoreline habitat upstream of the bridge crossing. While most of the impact is temporary, changes in substrate could contribute to minor, localized changes in species composition. These areas provide nesting habitat for species that guard their nests (e.g., bluegill, bass, white catfish), or attach or cast their eggs for attachment to vegetation (e.g., pumpkinseed, yellow perch). Because of the limited amount of habitat affected and the abundance of this habitat throughout the basin, a local change does not affect river fisheries.

Millers River. All of the new design alternatives result in partial filling of the Millers River. Because it currently does not sustain fish or forage, there is no permanent negative impact to fisheries of this river by any design. Low flow, high water temperatures, and low oxygen concentrations likely preclude fish and insects from using the shallow river.

Summary. There are no significant permanent fisheries impacts for Scheme Z and the three new design alternatives (for construction period impacts refer to Section 5.10.4).

4.5.5 Water Quality

4.5.5(a) Lower Charles And Millers Rivers

Following construction of the new dam and locks in 1976, tidal fluctuations within the lower Charles River have been effectively eliminated. The new dam is operated to maintain constant water depth in the Charles River, and is part of the flood protection measures for the low-lying areas of the Boston region. During storm events a large pumping station located at the dam is activated to evacuate large volumes from the Charles River Basin to prevent flooding.

The Millers River functions largely as a drainage channel for the approximately 1,000-acre Charles River drainage basin. The Millers River hydrologic, hydraulic, and hydrographic conditions are normally controlled by backwater from the Charles River. Therefore, the water fluctuations in the river are determined by the elevation of the Charles River. The Millers River flows through two subsurface 84-inch culverts located approximately 900 feet upstream of the Charles River dam and flood control pumping station.

The lower Charles River and the Millers River have been classified by the DEP/DWPC as Class B waters. Class B waters are designated for primary and secondary contact recreation, and as a habitat for fish, aquatic life, and wildlife. The most recent water quality data available suggest that Class B water quality standards are not consistently met in either the Charles or Millers Rivers. DEP has designated the Charles River Basin above the new dam as nonsupport (NS), indicating that the standard is not met. According to DEP, the Charles River Basin's water quality problems are high fecal coliform counts and low dissolved oxygen concentrations caused by combined sewer overflows (CSO), urban runoff, and sediments.

4.5.5(b) Permanent Impacts

Scheme Z identifies the following Project structures and work to take place in or adjacent to the lower Charles River and the Millers River: (For construction period impacts see Section 5.10.5).

- three new bridges over the Charles and Millers Rivers
- loop ramp structures east of and above the Millers River
- demolition of the existing Central Artery bridge over the Charles River

The new Charles River crossing design alternatives involve one to two bridges over and tunnels in the Charles and Millers Rivers, as well as partially filling the Millers River. The existing drainage culverts at the north end of the Millers River (its source) within the proposed fill area are extended southerly to discharge into the remaining Millers River, thus maintaining its detention basin function.

Both stormwater and tunnel washwater discharges are regulated by EPA and DEP under the National Pollutant Discharge Elimination System (NPDES) permit program and the Massachusetts Surface Water Discharge Permit Program, respectively. Stormwater flow generated on the roadway facilities in Scheme Z does not cause a significant degradation of water quality, and tunnel washdown water is discharged to sanitary sewers for treatment. All of the new design alternatives generate less stormwater flow than Scheme Z since more roadway is in tunnel. In addition, this stormwater from the viaducts is discharged downstream of the new Charles River locks and dams into Boston Harbor to avoid direct discharge of salt-laden water into the freshwater reach of the Charles River. The tunnel washdown water is discharged to sanitary sewers to provide for proper treatment before discharging to receiving waters.

Summary. Thus, all the new Charles River crossing alternatives have less impact on water quality than Scheme Z.

4.5.6 Other Aquatic Resources

The following sections discuss permanent impacts on other aquatic resources including waterbody modification, wildlife, floodplains, wild and scenic rivers, coastal barriers, and the coastal zone.

4.5.6(a) Waterbody Modification And Wildlife Impacts

Permanent waterbody modification impacts include fill in the northern portion of the Millers River and piers in the Charles River for overhead bridge structure.

Wildlife habitat impacts are minimal since there is little wildlife use of the lower Charles River Basin area. There is almost no means of access by terrestrial wildlife to the Charles River and the adjacent Millers River, as the rivers and their narrow fringe of vegetation are entirely surrounded by industrial or railroad lands. Birds using the Charles River will experience no long-term impacts from the Project.

4.5.6(b) Floodplain Impacts

The 100-year flood level in the lower Charles River and the Millers River is 104.3 feet. Because the water elevation in the Charles and Millers Rivers is controlled by the Charles River dam, any flood storage capacity lost between the present water surface (102.4) and 104.3 feet does not significantly change flood levels. Also, the Millers River has a relatively small watershed at the downstream end of the much larger Charles River watershed. During a 100-year flood event, therefore, the water from the Millers River watershed is released over the dam before the peak of the flood from the Charles River arrives at the dam. Lack of storage capacity in the Millers River, therefore, helps to desynchronize the flood peak in the lower Charles and alleviate flooding conditions. Accordingly, Scheme Z and the three new design alternatives have minimal permanent effects on the floodplains.

4.5.6(c) Wild And Scenic Rivers Impacts

There are no wild and scenic rivers in the vicinity of the Project.

4.5.6(d) Coastal Barriers Impacts

There are no coastal barriers in the vicinity of the Project.

4.5.6(e) Coastal Zone Impacts

The Charles River crossing is situated in an area of nontidal fresh water, upstream of the Charles River dam. The Project activities downstream of the existing I-93/Route 1 bridge are in the coastal zone, which is under the jurisdiction of the Massachusetts MCZM Program. The MCZM Program was established to protect and manage the development and use of the coastal zone under the provisions of the Federal Coastal Zone Management Act of 1972. This is accomplished by the MCZM office making certain that proposed developments in the zone are consistent with 27 regulatory and nonregulatory MCZM policies. All of the Project structures and construction activities are within or immediately proximate to the coastal zone and therefore may affect land or water uses within the area regulated by the MCZM Program. The Charles River crossing and its structures or activities are subject to a determination of consistency with the MCZM Program (see Appendix E).

On December 1, 1983, the MCZM issued conceptual concurrence that the 1983 DEIS/R proposed Project complied with CZM Program policies. This was reaffirmed by MCZM for Scheme Z in the 1991 FSEIS/R. The alternatives are consistent with MCZM policies.

4.5.7 Summary: Comparison Of Impacts By Scheme Z And The Three Alternatives

A new bridge crossing of the Charles River is a component of Scheme Z and the three new design alternatives; any such crossing requires placement of fill in limited areas of the Charles River and the Millers River for structures such as bridge piers. In addition, Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative require the construction of subaqueous river-tunnels. While overall long-term wetlands and water resources values are not significantly adversely affected by any of the four designs, the three new design alternatives do differ in a number of respects from Scheme Z and from each other with respect to aquatic impacts.

The smaller bridge structures and reduced number of piers in the three new design alternatives represent an improvement over Scheme Z. These bridge designs place less structure in non-tidal waters and also leave greater areas of the Charles River open, unshadowed, and unobstructed for navigation. With the removal of the existing I-93 bridge and its attendant piers (except the reverse "banana pier"), fill in the waters of the Charles River would, in fact, be decreased.

The two new river-tunnel alternatives result in substantial additional temporary impacts over large areas of river bottom for an extended multi-year construction period in comparison to Scheme Z and the Non-River Tunnel Alternative. These short-term impacts, which are addressed in Chapter 5, and are incorporated in the 404(b)(1) impact analysis described in Section 4.5.1(b) above, include the potential for increased disturbance of contaminated sediments, increased turbidity, restrictions on navigation, and interference with fisheries and water-related recreation. Project mitigation for these impacts would minimize these effects to the greatest extent possible.

The Millers River, a small, substantially degraded remnant of historic tidelands fillings, discharges urban stormwater and overland runoff from adjacent highway and industrial facilities into the Charles River via an artificial subterranean connection. It serves no wetlands functions except for sediment/toxicant retention and nutrient retention and transformation. The three new design alternatives all require fill in the northern portion of the Millers River. The loop ramps of all alternatives shade the Millers River and could result in an indirect loss of resource areas. Filling in a portion of the Millers River would not result in any significant loss of environmental values.

The Charles River crossing as a whole is a water dependent project requiring a location in and near wetlands and waterways. As recognized in all of the applicable State and Federal wetlands/waterways regulatory programs, any unavoidable potential adverse effects of fill in the Millers River under the three new design alternatives must be balanced against the positive benefits of the three new design alternatives to other significant aquatic, water-related, and general environmental values. In this regard, the three new design alternatives result in an improvement over Scheme Z in so far as aesthetic, open space, future park development, and water-related recreation factors are concerned. These factors are all considerations under Federal Section 404(b)(1) Guidelines (regarding impacts on the aquatic ecosystem). The three new design alternatives also enhance the availability and visual quality or public access to waterways (a principal policy concern of the state Chapter 91 program). As documented in detail in other sections of this DSEIS/R (i.e., Sections 4.2, 4.9, and the Section 4(f) analysis), the reduction in mass of the bridge structures crossing the Charles River, the loop ramp viaducts, and in the number of piers in both the Charles River and the Millers River achieved by the three new design alternatives will further enhance the successful creation of an integrated waterfront regional park system. These proposed park improvements will link the upper Charles River basin to Boston Harbor, thereby maximizing opportunities for the public to use and enjoy the river and its banks.

4.6 THREATENED OR ENDANGERED SPECIES

There are no known Federal-listed threatened or endangered species known to use the Area North of Causeway Street. The only such species found within the entire Project limits is the peregrine falcon. Locally, its habitat is restricted to the high-rise buildings of downtown Boston. While peregrine falcons have been known to frequent higher bridge structures in other cities, none have been reported in the structure of the existing Charles River high bridge, which will be removed as a result of the Project.

The Atlas Of Estimated Habitat Of State-Listed Rare Wetland Wildlife, produced by the Natural Heritage and Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife, indicates that no habitat for State-listed rare wetland wildlife species is found in the vicinity of the Charles River crossing. Accordingly, there are no long-term impacts of the Project to threatened or endangered species in the Area North of Causeway Street.

4.7 HISTORIC AND ARCHAEOLOGICAL RESOURCES

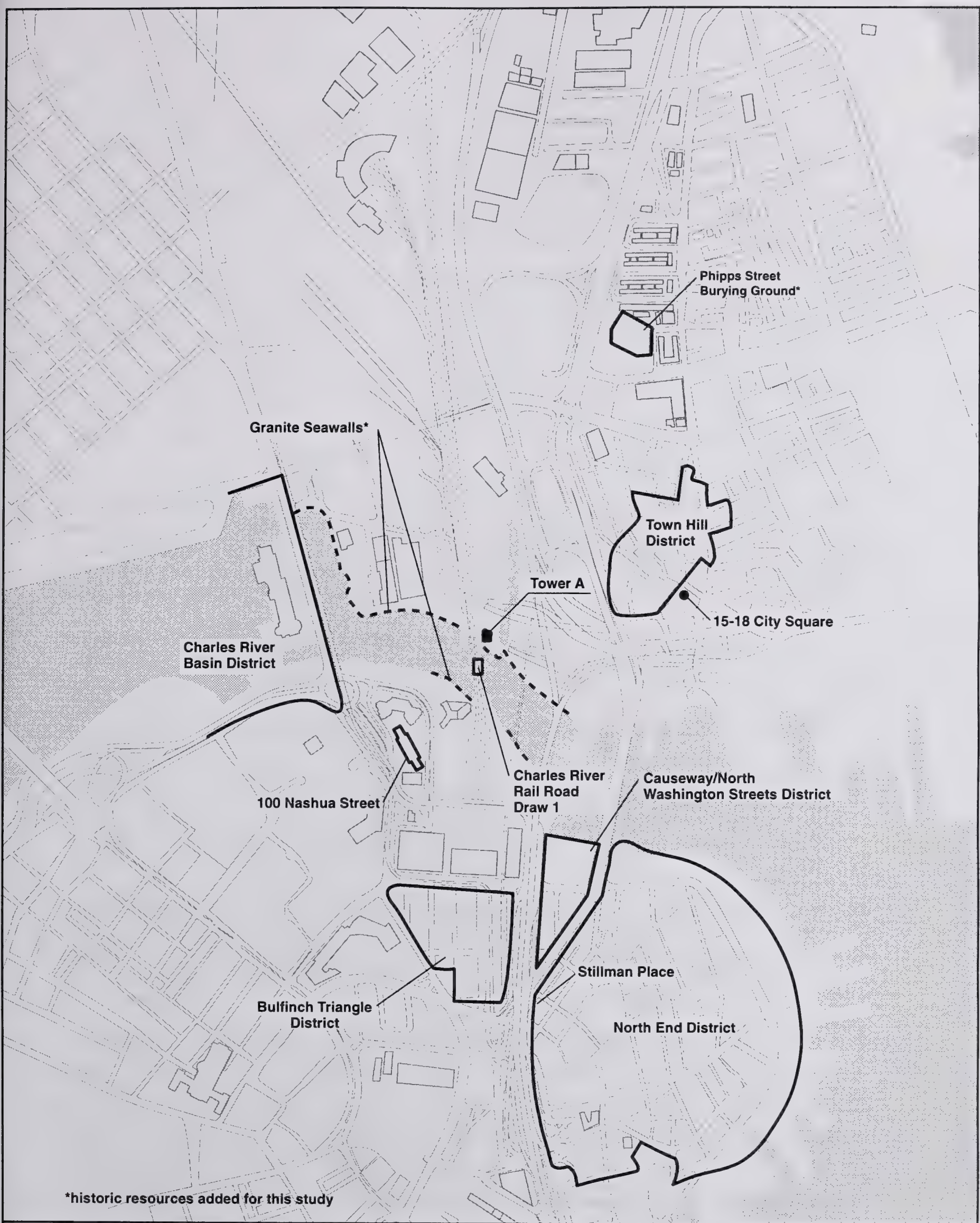
This section discusses long-term impacts on historic and archaeological resources of the three alternatives compared to the 1991 FSEIS/R Proposed Action (Scheme Z). New effects are identified and discussed.

4.7.1 Historic Resources

4.7.1(a) Affected Environment

This analysis is based on the current inventory of historic resources. The original inventory for the entire Project was prepared in 1982/83 for the 1985 FEIS/R and was updated for the 1991 FSEIS/R. Figure 4.44 shows the locations of the historic resources identified in the Area North of Causeway Street and in the adjacent Central Area, south of Causeway Street, which could be affected by the alternatives to Scheme Z.

MHD has implemented all four of the stipulations of the 1984 Memorandum of Agreement (MOA) among the Section 106 agencies and MHD which protects historic resources in the Project area. This MOA is included in both the 1985 FEIS/R and the 1991 FSEIS/R for the Project. MHD has also continued consultation with the State Historic Preservation Office (SHPO) and the Boston Landmarks Commission (BLC) through five meetings during the spring of 1993 to confirm effects on historic resources.



FIGURE

4.44

Historic Resources: Existing Conditions

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



The Advisory Council on Historic Preservation's criteria of Effect and Adverse Effect were used as guidelines for this analysis of effects on historic resources. The definitions for Adverse Effect, No Adverse Effect, construction period effects, and long-term effects remain as articulated in the 1991 FSEIS/R. For each historic resource for which adverse effects have been identified, specific measures to mitigate such effects are described. The basis of these recommendations is the set of mitigating measures stipulated in the MOA and reconfirmed in the 1991 FSEIS/R.

Changes Since The 1991 FSEIS/R. Within the study area no official changes have been made in the inventory since the 1991 FSEIS/R. However, two potential additions have been identified in the Area North of Causeway Street. The Phipps Street Burying Ground in Charlestown, off Rutherford Avenue, is now included because of the northward extension of the Project area. The original granite seawalls in the lower basin of the Charles River, between the Street Railway Viaduct (carrying the MBTA Green Line) and the new Charles River dam, have also been included in this analysis. The seawalls were added in response to a request in 1992 by the Section 106 cultural resources agencies, after approval of the FSEIS/R in January 1991.

4.7.1(b) Long-Term Impacts And Mitigation Measures

This section identifies all new possible effects of the alternatives, positive or negative, to historic resources. The resources, each identified by its inventory number, are described in geographic order, generally from north to south and west to east. Descriptions of resources already identified in the 1991 FSEIS/R are not repeated here; only the changed impacts on them, if any, are identified. The affected environment of the two potential additions to the inventory are also described in this section.

Phipps Street Burying Ground (A). The Phipps Street Burying Ground is significant for its role in the early settlement of Charlestown; its association with John Harvard, benefactor of Harvard College (presumably his burial place, it contains a granite obelisk erected to his memory in 1828 by Harvard graduates) and its collection of 17th through 19th century gravestones and tombs. Listed on the National Register, the burying ground is located off Rutherford Avenue between Miller and Dunstable Streets.

Because it is located outside of the Project limits in the 1991 FSEIS/R, the Phipps Street Burying Ground was not included in the Project's prior inventory of historic resources. However, since the Project limits have been extended northward to Sullivan Square, this historic resource now lies within the Project's secondary impact corridor. None of the four designs produces long-term effects on this property, however, due to its distance from the alignment.

Town Hill District (45). Scheme Z and the alternatives remove the existing elevated I-93 northbound structure, which stands 500 feet from the Town Hill District, and replace it with new structures which are farther away from this historic district. Each design, therefore, has positive long-term effects on the district by improving its visual setting. Scheme Z has no adverse effects on this district, and neither do the three alternatives.

15-18 City Square (40). Because of its distance from the alignment in all four designs, there is no long-term effect on this historic building.

Charles River Basin District (1). In Scheme Z and the alternatives, the existing traffic rotary at Leverett Circle is removed and its traffic movements reconfigured. The east curb line of Storrow Drive is moved 20 feet toward the Charles River Park apartments in Scheme Z and two alternatives (Reduced River-Tunnel and Non-River-Tunnel). Alternative 8.1D Mod 5 does not add an eastbound underpass, and therefore the curb line does not move. The Esplanade, on the riverside of Storrow Drive, is not affected in any of the four designs.

The contributing historic buildings located within the area of potential effects include the Streetcar Railway Viaduct, the MDC Police Headquarters and Lock House, and the old Charles River dam. Scheme Z was determined to have no adverse effect to the historic resources or historic character of the district. In addition, the alternatives have no adverse effects on these resources or on the character of the district.

Granite Seawalls In The Lower Basin Of The Charles River (B). The lower Basin includes the portion of the Charles River between the Streetcar Railway Viaduct (which forms the eastern boundary of the Charles River Basin Historic District) and the new Charles River dam. Potential historic resources newly identified in this area include a nearly continuous granite seawall on the northern (Cambridge/Charlestown) side of the river, which extends from the Streetcar Viaduct to the dam, and fragments of a granite seawall on the Boston side of the river.

Although these seawalls are not now included in the adjacent Charles River Basin Historic District, they are closely related to development of that district, and thus are considered historically and architecturally significant. Filling of the mudflats and marshes of the Charles River began in the late 18th century on the Cambridge side, and in the mid-19th century on the Boston side. The old Charles River dam was built between 1903 and 1910 to control the water level of the river Basin and to allow for a recreational reserve upstream. With the development of this area as a major metropolitan park, the Streetcar Railway Viaduct was added in 1910, in part to hide the unsightly railroad yards and wharves downstream. The granite seawalls in the lower Basin date from between 1910 and 1925, when the area was cleared up for rerouting traffic to the new North Station.

In all four designs, the construction of bridge footings affect the portion of the seawalls east of the MBTA commuter railroad bridge (Charles River Railroad Draw 1). This effect was not identified for Scheme Z, and the effect is similar in all three alternatives. Scheme Z and the Non-River-Tunnel Alternative affect only the seawalls that are east of the railroad bridge. However, Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative affect a substantially greater length of these seawalls that is west of the commuter railroad bridge. This effect is due to the cofferdam construction required for the river tunnels associated with these alternatives. These river tunnels are located west of the commuter railroad bridge.

The adverse effects of disturbing sections of these seawalls are mitigated through Stipulation 2 of the MOA, which governs similar work at Fort Point Channel. This stipulation provides specific design guidelines for the reuse of existing material and for the characteristics of new construction. It also calls for the Project Conservator's review of design and construction specifications. Any portions of the seawalls to be disturbed would therefore be disassembled and rebuilt with existing materials, or in-kind, to match existing conditions. As a result, no long-term adverse effect on this resource is expected in any of the designs.

Tower A (70). Scheme Z retains viaduct ramps directly over the historic building. By relocating the viaduct loop ramps away from Tower A, all alternatives reduce the adverse visual impacts on the structure that are described in the FSEIS/R. The building continues to be operational in all alternatives.

Scheme Z: Overhead viaduct ramps connecting I-93 northbound and Route 1 northbound negatively affect the visual setting of Tower A by passing 2 to 4 feet overhead and obstructing views of the historic building.

Alternative 8.1D Mod 5: This alternative locates the viaduct loop that leads to I-93 southbound (Ramp T-C) approximately 80 feet away from Tower A. The exhaust duct for the tunnel leading to I-93

northbound and Route 1 northbound (Ramps SN and C-T) is located partially under Tower A, and the tunnel itself passes within 15 feet of the building. Underpinning of Tower A is required prior to construction, but no long-term adverse effects to the building are expected.

Reduced River-Tunnel Alternative: The viaduct loop connecting I-93 northbound and Route 1 northbound (Ramp C-T) is located approximately 40 feet away from Tower A in this alternative. The tunnel leading to Route 1 northbound (Ramp S-N) passes within 10 feet of Tower A. No long-term effects to the building are expected.

Non-River-Tunnel Alternative: The viaduct loop connecting I-93 northbound and Route 1 northbound is located approximately 30 feet away from Tower A. No long-term effects to the building are expected.

Charles River Railroad Draw 1 (38). In Scheme Z, the bridges for the Charles River crossing are located approximately 50 to 80 feet downstream of the Charles River Railroad Draw 1. Scheme Z was determined to have no long-term effects on this historic bridge. The bridges of the Non-River-Tunnel Alternative are similarly located with regard to the Railroad Draw, and therefore will have no change in effect. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative also have no change in impacts from Scheme Z. In fact, in both of these alternatives, the new river bridge is located farther away from the historic bridge, more than 200 feet downstream.

Charlestown/North Washington Street Bridge (36). Because of its distance from the alignment in all four designs, there is no long-term effect on this historic structure.

100 Nashua Street (Registry Of Motor Vehicles) (37). While Scheme Z was determined to have no long-term effects on the historic Registry building, alternatives have potential adverse effects. All alternatives locate a tunnel from Storrow Drive underneath the Registry building, whose facade system is already in fragile condition. Underpinning of the building is required, along with preventive treatment for the facade. Potential long-term effects from settlement and vibration (both construction- and traffic-related) are mitigated by stabilization of the facade, or, if necessary, by removal of the facade, underpinning of the building, and restoration of the facade with existing or in-kind materials. Further study of the existing design and physical condition of the facade system will be undertaken to determine the appropriate extent of required preservation work.

Under Stipulation 4 of the MOA, the Project Conservator, SHPO, and BLC will review design and construction specifications for this work. As a result of these mitigation measures, there will be no long-term adverse effect on the historic building. Moreover, by addressing a serious pre-existing problem, the three alternatives will improve the long-term condition of the building.

In addition, in all three alternatives, a new at-grade off-ramp to Nashua Street is located within 20 feet of and parallel to the rear of the building. The resulting change in the building's visual setting will not substantially impair its physical integrity or historic attributes, and no adverse effect is predicted.

The location and design of any ventilation building near the Registry building has potential impacts to its visual setting. Scheme Z requires no ventilation building. In Alternative 8.1.D Mod 5, ventilation building 8 is located above grade, 230 feet from 100 Nashua Street, on the site of the existing Spaulding Rehabilitation Hospital. This ventilation building is approximately 160 feet long by 120 feet wide and 60 feet high, with eight exhaust stacks.

The maximum building height allowed by zoning in this area is 320 to 330 feet. Although the height of the exhaust stacks has not been determined at this time, they must be taller than surrounding buildings.

The visual impact of this new structure is mitigated through the design review process established by Stipulation 4 of the MOA. Recognizing that the setting for the Registry building is already heterogeneous in siting, massing, materials, character, and use, the long-term visual effect of the ventilation building is not expected to be adverse.

In both the Reduced River-Tunnel and Non-River-Tunnel Alternatives, proposed ventilation buildings are located below grade. In the Non-River-Tunnel Alternative, this structure is located 100 feet away and directly across the street, while in the Reduced River-Tunnel Alternative, the structure is some 230 feet away, diagonally across the street. Although the exhaust stacks will be visible, their appearance will be mitigated as in Alternative 8.1D Mod 5. They are, therefore, expected to have no long-term adverse effect on the Registry building. Joint development guidelines for this area will include preservation criteria to enhance the character and integrity of historic resources such as 100 Nashua Street.

Causeway/North Washington Streets District (21). Scheme Z was determined to have no long-term adverse effects on this district, and all three alternatives have no change in long-term effects. All four designs have a long-term positive effect by removing the existing Central Artery viaduct and thereby enhancing the district's setting. Joint development guidelines for this area will contain preservation criteria to enhance the character and integrity of the district.

Bulfinch Triangle District (2). Scheme Z was determined to have no long-term adverse effects on this district, and there is no change in effect in any of the alternatives. All four designs have a long-term positive effect by removing the existing Central Artery viaduct, thereby enhancing the district's setting. Joint development guidelines for this area will contain preservation criteria to enhance the character and integrity of the district.

North End District (22). Scheme Z was determined to have no long-term adverse effects on this district. All four designs have a long-term positive effect by removing the existing Central Artery viaduct and thereby enhancing the district's setting. Joint development guidelines for this area will contain preservation criteria to enhance the character and integrity of the district. All alternatives to Scheme Z include new long-term effects on historic attributes of the district due to the proximity of the proposed surface road to 2-6 Stillman Place.

Scheme Z contains a northbound surface road that is located approximately 35 feet away from Stillman Place, with no adverse effect on the historic streetscape. In the alternatives, however, the addition of a new downtown on-ramp moves the northbound surface road within 10 feet of the closest of these buildings.

As noted above, the visual setting of this streetscape is substantially improved by the removal of the existing viaduct, which passes within approximately 20 feet of the end building on Stillman Place. In Scheme Z this surface road is three lanes wide, while the closer alternatives feature a two-lane surface road. Traffic levels are substantially lower (by 15 to 40 percent, depending on the time of day) in all the alternatives compared to Scheme Z. These reductions in traffic are due to the same design change which requires the surface artery to be aligned closer to the rowhouses.

The surface road design is subject to review by the Project Conservator, SHPO, and BLC through Stipulation 4 of the MOA. As a result of these mitigating conditions, this alteration in the setting of Stillman Place is not expected to substantially impair the integrity or attributes of the historic streetscape, and no long-term adverse effect is predicted.

In the alternatives, resurfacing of a portion of Stillman Place is necessary as part of the construction of the new surface road. To mitigate this potential adverse effect, existing granite paving blocks will be reused or replaced in kind, and existing granite bollards removed, stored, and replaced. No long-term adverse effects are predicted from the resurfacing.

Summary. Generally, none of the alternatives has adverse long-term effects that significantly impair the integrity and attributes of the historic resources in the affected area.

4.7.2 Archaeological Resources

This section provides new information not included in the 1991 FSEIS/R regarding archaeological resources in the Area North of Causeway Street Project subarea, north of the Gilmore Bridge, to the northern Project unit near Sullivan Square. This extended area is affected by the three new design alternatives but not Scheme Z (the 1991 Proposed Action). Most of the work for Scheme Z lies in Charlestown, south of the Gilmore Bridge. The three new alternative designs occupy largely the same area, with the exceptions of (1) a proposed I-93 northbound off-ramp to Rutherford Avenue that is located just north of the Gilmore Bridge, and (2) a new collector/distributor road, parallel to and west of the I-93 mainline, that begins at the existing I-93 stub.

The area south of the Gilmore Bridge was covered previously in the 1991 FSEIS/R and by the CANA project, and the identification of potential resources and Project impacts in that area remains virtually the same. The following analysis, therefore, focuses on the area north of the Gilmore Bridge to Sullivan Square. A Phase I, Step I (reconnaissance level) archaeological survey will be completed before the FSEIS/R is submitted to the cultural resources agencies for review, and will be considered in the selection of the preferred alternative by MHD.

4.7.2(a) Previous Environmental Documentation

As described in the 1991 FSEIS/R, the Area North of Causeway Street was studied and evaluated in a Phase I, Step 1 archaeological survey report for the full Project area in 1982, followed by a Phase I, Step 2 survey in 1988. In 1989, a Phase II field investigation was completed, and its recommendations were reviewed and approved by MHD, FHWA, the SHPO, and BLC later that year.

The Phase I archaeological report for the entire Project area (Boston University, 1989) fully evaluated the parts of Charlestown south of the Gilmore Bridge, as well as the lower basin of the Charles River between Leverett Circle and the Charlestown/North Washington Street Bridge. The 1988 report concluded that it was unlikely that anticipated archaeological resources in these parts of the study area south of the Gilmore Bridge retained enough significance or integrity to be considered eligible for the National Register.

4.7.2(b) Affected Environment

Scheme Z and the three new design alternatives involve construction in areas that now contain streets, buildings, railroad yards, and open commercial and industrial sites characteristic of an urban landscape. However, in its 17th century configuration, much of the Area North of Causeway Street study area comprised tidal embayments in the Charles River, and the Millers River embayment between Charlestown and Cambridge. Charlestown Neck formed the northern end of the latter embayment, separating it from the Mystic River estuary and providing land access to the Charlestown peninsula. As shown in Figure 4.45, the study area north of the Gilmore Bridge is largely contained within the original Millers River embayment.

During the course of the 19th century, these embayments were filled in and wharved out, usually in connection with the construction of commercial and transportation facilities. Previous archaeological work in Charlestown indicates that the fill deposits may be as much as 15 to 20 feet thick.

In all three alternatives to Scheme Z, a proposed off-ramp to Rutherford Avenue crosses what was the Millers River embayment and ends close to the original shoreline. The proposed collector/distributor road north of the Gilmore Bridge may cross the original shoreline at several points along the western side of the original Millers River.

Potential archaeological sites in the study area may therefore include prehistoric sites associated with coastal land forms, historic waterfront structures within landfill, and later historic period structures associated with the upper levels of fill.

National Register criteria will continue to be used to evaluate the significance and integrity of potential archaeological sites in this area. As in the 1991 FSEIS/R, the categories of expected archaeological resources having the potential to meet National Register criteria will include: prehistoric sites; settlements and structures; wharves and wharf-related sites; landfill; manufacturing and industrial sites; and transportation-related sites.

Identified Archaeological Resources. The study area north of the Gilmore Bridge contains no recorded prehistoric or historic period archaeological sites. In addition, this Project area also contains no properties that are currently listed on, or have been determined eligible for inclusion in, the National or State Registers of Historic Places.

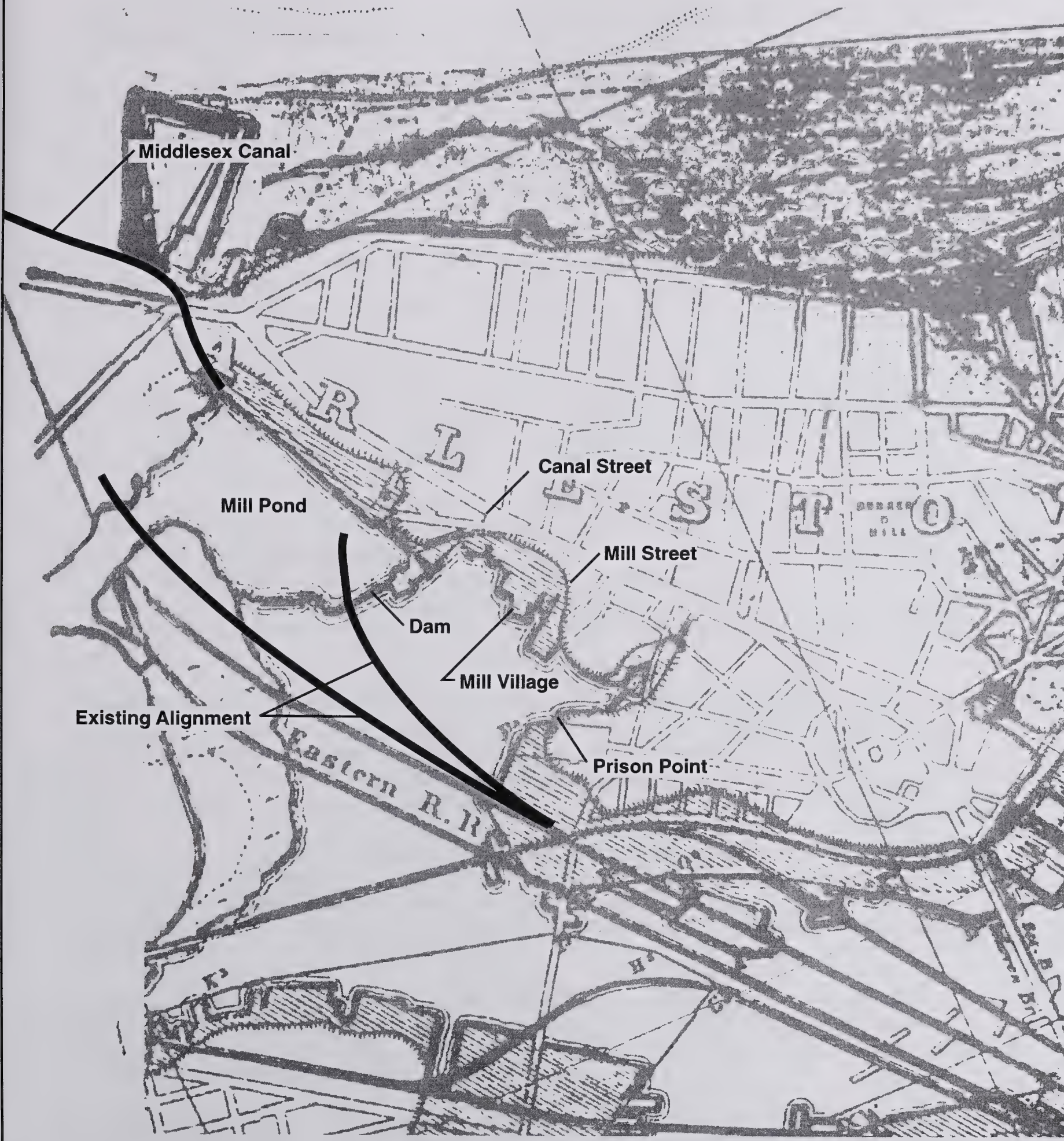
One archaeological site near the Project area has been recorded. This site (19-SU-44) is located west of Rutherford Avenue, opposite the Austin Street intersection, in the area of Bunker Hill Community College. The site has tentatively been identified as a Contact Period village, and could provide significant information about Native American-English interactions in the early 17th century. However, it is probable that construction of the college (as well as construction of the prison complex that was previously located there) largely if not entirely destroyed whatever portions of the archaeological site were located on the grounds. This site is outside the impact area of the proposed Rutherford Avenue off-ramp.

Potential Archaeological Sites. Archival review conducted to date indicates that the following potentially significant archaeological resources may occur within the study area north of the Gilmore Bridge.

Prehistoric Sites Within The Former Millers River Embayment: Such sites might include fish weirs and occupation sites inundated by rising sealevels and subsequently covered by historic period fill. These sites could be located in the area of the proposed Rutherford off-ramp, and on the original shoreline west and south of Sullivan Square, underneath the alignment of the proposed collector-distributor roadway.

Tide Mill At Mill And Essex Streets: The Millers River embayment may contain remains of the tidal mill itself, which was established in 1675; a 0.25 mile long dam at the head of the embayment, which ran from a point on the eastern shore just south of Rutherford Avenue and Essex Street to land now occupied by H.P. Hood & Co. on the western shore; buried wharving along the eastern shore of the bay; and structures associated with the mill village along the original shoreline. Such archaeological sites have the potential to reveal valuable information about early tidal mill construction.

The proposed Rutherford Avenue off-ramp crosses the dam itself, but should not extend to the suspected area of the mill seats or locks. The proposed collector/distributor roadway does not cross any known



FIGURE

4.45

Archaeological Sites

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY /TUNNEL PROJECT



facilities associated with the tidal mill pond. This site has been covered by late 19th century fill, railroad construction, and industrial development.

Terminus Of The Middlesex Canal At Charlestown Neck: This transportation-related complex may contain remains of structures associated with the Middlesex Canal, an early and innovative example of its type that was built between 1798 and 1803. Associated features include the Canal itself, locks, tow paths, auxiliary buildings, a wharf, and potential sunken barges and their cargo. Such archaeological sites could provide valuable information about early canal construction and operations.

The proposed Rutherford off-ramp impact area crosses the tidal pond dam, but does not include the area of the lower lock and on-shore Canal facilities. The proposed collector-distributor roadway passes near the location of the upper lock. As part of the mill pond area, this site has been covered by late 19th century fill, railroad construction, and industrial development.

4.7.2(c) Potential Impacts To Archaeological Resources

The survival of one known prehistoric site near the Project area suggests that other prehistoric and/or historic period archaeological sites may exist where the alternative alignments cross the original shoreline. These potential resources may already have been adversely affected, however, by 19th century and more recent construction, including construction of the existing I-93 viaduct structure.

The identified potential archaeological resources within the study area consist of prehistoric sites and wooden or earthen historic site features, all of which are very fragile and difficult to detect except by controlled excavation. The relatively slow rate of development in the study area until the 1870s, followed by rapid filling of the entire area, suggests that preservation of these sites is possible. Moreover, because the depth of fill in the study area is on the order of 10 to 20 feet, the late 19th and early 20th century construction of rail yards and other facilities may not have significantly impacted surviving archaeological sites.

The potential impacts of the proposed Rutherford Avenue off-ramp and collector/distributor roadway on surviving archaeological sites fall into two categories, intermittent and continuous. First, the intermittent supports for the collector/distributor viaduct and the above-grade sections of the off-ramp will create disturbances to depths that exceed the thickness of the late-19th century fill, and could adversely affect any archaeological remains located at piling positions.

The piles are currently expected to be 50 to 60 feet deep, with pile caps typically 15 by 20 feet in plan and 6 to 8 feet deep. Piles will be driven approximately every 100 feet, for a total of approximately 15 footing locations along the viaduct for the proposed collector-distributor roadway. Three to five of these footing positions might be located near the original Millers River shoreline, which may contain potential prehistoric resources.

The viaduct structure for the proposed Rutherford Avenue off-ramp does not cross the original shoreline. Portions of this construction, however, could affect potential resources related to the mill pond dam. Approximately 600 feet of the viaduct for this off-ramp is located in the potential impact area, which would therefore include approximately six footing positions.

Secondly, the at-grade section of the proposed Rutherford Avenue off-ramp will create a continuous disturbance, but one which is limited in depth. Approximately 550 feet long, this at-grade section does not extend to the original shoreline, and its construction should not exceed the thickness of historic fill. The at-grade roadway therefore has a low potential to disturb archaeological resources.

4.7.2(d) Identification And Mitigation Of Potential Impacts

Current archaeological survey work for the study area north of the Gilmore Bridge has employed historic maps, town and other histories, and archaeological and cultural resource management reports. The analysis of these materials applies both to the general impact area and to specific archaeological resources.

Further work to be done is in two parts. First, previous soil borings, excavation records, and/or geotechnical analysis for this area will be reviewed, particularly for the existing I-93 viaduct structure. Analysis of existing borings will provide general information on the location of significant original land forms and/or fill areas in the overall study area. This work will be completed for the FSEIS/R and accompanying technical report.

Second, new soil borings and geotechnical analyses conducted specifically for the Project will be monitored as they become available. This review will provide detailed information for specific impact areas on subsurface conditions and the location of significant original land forms and/or fill materials.

Based on the results of these two activities, any specific portion of the study area north of the Gilmore Bridge with a relatively high potential to contain significant resources will be identified. If the selected design involves the Rutherford Avenue off-ramp or collector-distributor roadway, these high-potential locations would be subject to more detailed archaeological investigation during subsequent design phases. If necessary, such investigation would include limited subsurface testing to locate and evaluate archaeological resources. Adverse impacts to any significant sites could be avoided by adjusting viaduct footing locations, changing the construction method to one with lesser impacts, or undertaking Phase III data recovery.

Areas with a lower probability of significant and intact resources will be monitored during construction, in accordance with the 1984 MOA, which outlines the Project's commitments to archaeological resources. Should evidence of significant prehistoric or historic period sites be detected during construction, the Project's existing mitigation program, as described in the 1991 FSEIS/R, would go into effect. Such sites would undergo archaeological salvage work under the terms of the Project's contingency plan, MHC regulations, and the existing MOA.

4.8 HAZARDOUS WASTE SITES

MHD and the DEP Massachusetts have developed protocols for the assessment and characterization of soils and groundwater along the Project alignment. As detailed in the 1991 FSEIS/R, this assessment and characterization process seeks to identify the nature and extent of contamination within each parcel along the Project right-of-way (ROW) both through historic record searches and extensive field sampling. The purpose of this process is to identify and delineate any areas of the ROW which are heavily contaminated with petroleum or hazardous materials so that removal and treatment or disposal of contaminated soils or hazardous wastes can be performed, in accordance with Federal and State requirements. To date, no hazardous waste sites or areas of extensive soil or groundwater contamination have been identified through this process in the Area North of Causeway Street. Sample results so far indicate the presence of oil and other soil contaminants consistent with the railroad and industrial history of the area.

The assessment and characterization process proceeds in three phases: initial assessment (including research into historic uses of the site and records of prior releases of oil or hazardous material), field characterization through soil and groundwater testing, and delineation of heavily contaminated areas. Reports are prepared for each of the phases and submitted to DEP for review and approval. Following these steps, detailed plans and specifications are provided to DEP, showing the nature and extent of contamination, and the measures for containment, treatment, and/or removal of contaminated soils. These

plans, which require DEP approval, also address the treatment or disposal of groundwater encountered during excavation. During construction, compliance with the plans is monitored, and all excavated soils are sampled before disposal. All soils are tracked by means of bills of lading or waste manifests, as appropriate.

As part of the assessment and characterization process, MHD has conducted a record search for known sites requiring remediation under either the Resource, Conservation and Recovery Act (RCRA) or the Comprehensive Environmental Response, Compensational Liability Act (CERCLA), as amended. This search revealed no known or listed Federal remedial sites under either RCRA or CERCLA. In addition, MHD has conducted sampling of soils along the north bank of the Charles River in Cambridge and Boston (Charlestown). Five soil borings were performed along the riverbank, to a depth between 35 and 50 feet. Two borings were performed on the south bank, in the vicinity of the existing I-93 bridge, to depths of 34 and 60 feet. The results of chemical analyses performed on soils from these borings indicated the presence of metals and petroleum hydrocarbons in the historic fill materials and in native soils, at levels generally typical of urban soils. Two borings showed levels of contaminants significantly higher than typical levels, in native material at depths of 35 to 37 feet. None of the samples showed elevated levels of contaminants which would indicate a need for special measures to remove or treat the soils.²

Previous soil borings, performed in the areas that would be affected by Scheme Z, showed the presence of elevated levels of metals, petroleum hydrocarbons, and polynuclear aromatic hydrocarbons (PAH). Levels of metals detected in these borings were below the thresholds established by RCRA for hazardous wastes. Removal and disposal of these soils therefore does not appear to be subject to Federal hazardous waste regulations. Levels of petroleum contamination in two borings were high enough to warrant further definition of the extent of contamination. These borings were located in areas historically associated with railroad yard activity.

The limits of the Project area for this DSEIS/R have been extended northerly along the I-93 corridor from just south of the Gilmore Bridge in Cambridge to near Sullivan Square in eastern Somerville/Charlestown. This additional study area consists of land uses that are predominantly transportation and business/commercial. MHD plans to assess and characterize soils in this area under the program outlined above.

At present, no hazardous waste sites have been identified within the Project area for this DSEIS/R. The long-term impacts on the Project of soil and groundwater contamination with oil or hazardous materials will be determined once the preferred alternative is selected and further testing and characterization is completed.

4.9 VISUAL IMPACTS

This section describes visual impacts of the 1991 Proposed Action (Scheme Z) and its three alternatives in the Area North of Causeway Street and discusses proposed mitigation and enhancement measures. The visual impacts include views of the Project from the surrounding areas, and views of the surrounding areas from the Project. This description of the visual impacts of Scheme Z and the three new alternatives assumes the construction of bridges as described in Chapter 2. As noted in Chapter 2, the final bridge selection is subject to an FHWA bridge design type study. Following Section 4.9 are Figures 4.46 through 4.61, showing views of the alternatives, and Table 4.42 which compares visual impacts.

²[ref.: CDM Final Sampling and Analysis Summary Memorandum, Charles River Crossing Alternatives, Design Package DO19A, February 1993]

4.9.1 Affected Environment

The Area North of Causeway Street is dominated by steel viaducts, inaccessible open spaces, parking lots at grade, and industrial warehouses. The area is visible from surrounding bridges and viaducts. On the west, the historic Street Railway Viaduct carries the elevated MBTA Green Line. On the east, the North Washington Street bridge connects Rutherford Avenue in Charlestown with North Washington Street in Boston. On the north, the relatively new Gilmore Bridge carries traffic between Charlestown and Cambridge over railroad yards. On the south, the area is defined by the Storrow Drive connector viaduct to I-93. Mid-rise buildings are located along Causeway Street including the aging North Station/Boston Garden building and the new O'Neill Federal Office Building. Finally, the elevated I-93 traverses the lower Charles River Basin. The proposed MDC parkland master plan, New Boston Garden and other proposed development in the area would significantly alter the visual setting in the lower Charles River Basin area. At present it is primarily pedestrians and railroad passengers who view the area at ground level; to a lesser extent motorists have ground-level views.

4.9.2 Impacts

Scheme Z and the three new alternatives reconfigure approximately 165 acres of semi-industrial and underused land and waterways near downtown Boston. The immediate area is affected by four major physical components: riverfront parkland, river uses, transportation infrastructure, and several new buildings. Any crossing is partly visible from the surrounding residential, commercial, and institutional communities. These components of the immediate area, and the surrounding communities from where the components are visible, together constitute the visual impact environment.

The impacts on the components of this environment include the views of and from: (1) the road, (2) the waterways, (3) the parkland, and (4) the Project-related building structures.

- **View of and from the road:** Scheme Z and the three new alternatives include unique traffic moves along the highway system (tunnels, surface, and viaduct). Highways and roads have three sources of visible impacts; traffic volume and road design, including number of lanes, lane width, curvature, and sight lines; the planning of the surrounding landscape and the abutting parcel development for efficient and compatible traffic circulation; and pedestrian circulation. All surrounding historic monuments and church steeples are too distant to be adversely affected visually by the Project structure.
- **Waterways:** The waterways in this area include the Charles River and Millers River.
- **Parkland:** The 1991 FSEIS/R proposed parkland associated with Scheme Z retains much of the existing shoreline and does not fully prescribe uses. It does not include the parkland development proposed in the 1993 MDC master plan for the lower Charles River Basin. The 1993 master plan would create recreational areas defined by a remodeled shoreline and new public attractions. The plan gives the area distinct appearances from the other adjacent parklands and from the surrounding residential, commercial, and institutional communities that are primarily urban development zones.
- **Project-related buildings:** The Project introduces tunnel ventilation buildings, electrical substations, and tunnel stairs enclosed in "headhouses." All the Project buildings are being located and designed to complement the desired future land uses. Three MHD facilities, an emergency station, an emergency platform, and a satellite maintenance facility, will also be in

the area, but have not yet been sited. In addition, MHD is examining relocation options for the existing MDC central services facility located in the North Point area in the vicinity.

4.9.2(a) Scheme Z

Scheme Z creates a noticeable impact on the visual environment of motorists, pedestrians, and adjacent buildings. Three new bridges cross the Charles River, lower and wider than the existing bridge, and a vast multilevel ramp system impose on North Point and the north bank of the Charles River.

View Of And From The Road. Scheme Z includes 16 lanes of traffic crossing the Charles River on viaducts, 275 feet in width including gaps between them. Ten lanes in six loop ramps on the north bank of the Charles River are partially over the proposed North Point multiuse development site. Six lanes of traffic (CN-S and S-CS, the Storrow connector viaduct) connect Storrow Drive to I-93 northbound and southbound. The design has three bridges: two five- to six-lane long-span bridges and one six-lane double-deck medium-span bridge. The long-span bridge and the medium-span bridge have different profiles. The long-span bridges are supported by two A-frame towers, 330 feet high on both north and south banks. There are 11 piers in the water and many on land, each having a diameter of approximately 8 feet. Added to these views is the traffic on the viaducts, which is visible from the affected environment.

Viaducts: The two-tier Storrow Drive connector viaduct and the six loop ramps vary in height between I-93 and City Square, interrupt views of Bunker Hill, the new Boston Garden, the Charles River, and northeast and northwest to Charlestown and Somerville. The bridge has one tower on the south with one pier in water and the other on the bank. The bridge also has a tower with two piers in the water close to the north bank. On the I-93 northbound and southbound viaducts, drivers experience an inclined road between Portal Park and the north bank. Drivers on the Storrow connector viaduct travel at approximately level gradient alongside I-93. I-93 slopes up toward the north, and descends in the loop ramps to City Square. As a result, drivers view their surroundings from points between 35 and 100 feet above water. Most views of their surroundings are experienced by travelling south toward Boston. Elevated views are possible, but numerous viaducts crossing overhead disrupt views. Consequently, drivers are sometimes in the shadow of other viaducts and piers.

Surface Roads: Martha Road is a local traffic distributor to the Charles River Park apartment complex. The other adjacent surface streets provide connections to and from O'Brien Highway, Storrow Drive, and Causeway Street. The visual environment is complicated by the transition of the MBTA Green Line from tunnel to viaduct.

The service road from Rutherford Avenue which partially fills the Millers River to access BSG is screened from Charlestown and the north bank park by landscaping, and is adjacent to industrially zoned areas. Landscape design screens the transportation uses from the adjacent residential areas.

Tunnels: There are two short tunnels under Leverett Circle. One reuses the existing underpass; the other is new. Their visual impact is consistent with the overall appearance of the roads.

Waterways. In Scheme Z, I-93 passes a minimum of 23 feet over the Charles River at the recreational lock. The bridge is supported by 11 piers in the water that align with the north-south axis of the highway rather than with the direction of the river or the riverbanks.

Impacts on the view from the Charles River are similar to those described below as parkland impacts. Further, the location and orientation of piers in the water visually dominate the river, and create a 270-foot-long corridor of shadow, interspersed with 3 gaps totalling 65 feet. The piers interrupt the view to

the water environment on the other side of the overhead highway. The bank is skewed to the bridge alignment, reducing the width of the water sheet at this location.

Parkland. In Scheme Z, the parkland is narrowed along the river and partly in shadow, due to the loop ramps. The granite seawall would be restored at the west edge of North Point, the south bank adjacent to the bridge pier, and the north bank would be west of the bridge pier. The proposed parkland is complimentary to several surrounding new buildings, and would be connected across the Charles River by a pedestrian bridge alongside the MBTA railroad bridge.

Pedestrians on the south bank would have access under the I-93 viaducts alongside the Charles River, with approximately 10 feet of overhead clearance. Pedestrians on the north bank have ample riverfront views under the I-93 viaducts, although in a shadowed area.

Project-Related Buildings. No ventilation buildings are required. No tunnel egress stair headhouses are required.

4.9.2(b) Alternative 8.1D Mod 5

The visual impact of this alternative differs substantially from Scheme Z because of the extensive use of tunnels instead of viaducts. The view of this alternative from the surroundings is improved compared to Scheme Z. In the extensive system of tunnels, the visual experience of the motorist is complex.

View Of And From The Road. Alternative 8.1D Mod 5 has 10 lanes of traffic crossing the Charles River on single bridge structure, 170 feet wide and supported by two "needle towers" approximately 290 feet high located on the north bank. One bridge pier is in the water. Two lanes on one elevated loop ramp carry traffic between City Square (Charlestown) and I-93. Two lanes of elevated traffic (Ramp N-S) travel southbound on elevated structure to connect Storrow Drive to I-93 northbound.

Viaducts: Motorists on the mainline are a minimum of approximately 35 feet above water, and have views in all directions. Drivers experience an inclined road surface between Portal Park at Causeway Street and the north bank. A single two-lane off-ramp to City Square passes under the I-93 mainline to reach grade.

Surface Roads: In the Martha Road/Lomasney Way corridor, Martha Road retains its existing appearance, although at Leverett Circle and Lomasney Way/Nashua Street it meets a complex intersection of arterial roads and driveways. The 210-foot-wide corridor between buildings has Project-related viaducts, tunnels, and transitional surface roads, and the MBTA Green Line. It is unlikely to warrant a pedestrian amenity except at sidewalks that front buildings, or at tunnel egress stairs if required.

The surface roads off Rutherford Avenue are in an existing industrial area. With landscaping, they comprise a visually enhanced area around BSG, as viewed from the north bank. In order to reach BSG a portion of the Millers River is filled.

Tunnels: The tunnels of this alternative (over 10,000 lf) include tight radii, difficult merges, and long durations in tunnel, due to geometrically complex tunnel alignments. They include a 360-degree tight turn, with changing gradient and broad curves. In addition, nine different routes can be taken, each with entrance and exit ramps surfacing in different areas of the city.

For instance, Ramp S-N has a tight 360-degree radius for approximately 850 lf. This challenges motorists' perceptions and orientations. This adverse impact is reduced somewhat by coordinating tunnel architecture with roadway design. Ramps C-T, CT-SN, and S-N provide long passages in curved tunnels,

where forward lines of sight are improved by sight shelves. On the other hand, vertical lines of sight are critical in Ramps C-T, M-N, C-T, and S-N. Here, particular design attention is given to tunnel roofs and the placement of overhead signs to maximize the views of the road ahead. Ramps merge with or separate from other lanes at several places: Ramp C-T merges with M-N; Ramp C-T with S-N; Ramp L-C separates from S-N; and G-T from CN-S. In these cases, the design reduces the visible confusion with simple, uncluttered, coordinated elements.

Parkland. This alternative has 6 fewer traffic lanes on viaduct than Scheme Z and its piers have manageable impacts on the parkland. Motorists have views of the surrounding parkland, without any sections hidden by viaduct, highway elements, or Project-related buildings. Viewed from the surroundings, the highway and Project-related buildings blend with the parkland.

Pedestrians on the north bank have a clear view and access under the I-93 viaducts to connect North Point and Paul Revere Landing Park North. In comparison to Scheme Z, the highway impacts on the parkland are modest. The remodeled shoreline coupled with the MDC master plan public interest exhibit under the bridge makes this environment pleasant for pedestrians. Pedestrians on the south bank have clear views and access under the I-93 viaducts between Lovejoy Wharf and the MBTA railroad tracks. A remodeled shoreline in this area combines their path with the architecture of the bridge abutment.

Waterways. As proposed in the MDC master plan, the Charles River has a reconfigured shoreline. The change would provide the bridge piers with a foundation on the north bank, making the Charles River visibly narrower at this point. There are no visual impacts on the water environment from viaduct piers. The I-93 bridge passes between 23 and 65 feet above the Charles River, casting shadows on the water, although permitting light to penetrate between viaducts in two gaps of approximately 12 feet each. The view from the water demands that the I-93 underdeck have a high-quality design. Unhindered views are available upstream, downstream, south to the City of Boston, and north to Bunker Hill. The viaduct loop ramp partially block views northeast in the path of I-93; the existing I-93 does as well. The coordinated design of visible highway elements enhances the water environment.

Project-Related Buildings. This alternative has one ventilation building located on the south bank, surrounded on all sides by a joint development parcel (see Section 4.2.5, Joint Development Impacts). An electrical substation will be located on the north bank. Headhouses for tunnel egress stairs will be located on the north and south banks above tunnels.

The main visual impact of the ventilation building is from eight exhaust-air discharge stacks and, depending on where they are located, the supply-air intake louvers. In any event, louvers are above the surrounding pedestrian level. The building shadows parkland on the south bank. Situated close to the Charles River, it occupies land with optimum riverfront views. The eight stacks obstruct river views from buildings to the south. In the initial stages the building may stand alone on its site if the surrounding parcels are not developed simultaneously. In this event, landscape design will help prevent the potentially stark silhouette of the building against the park and river. The massing of the building respects the adjacent pedestrian environment along the east side of Nashua Street and north along the Charles River Basin.

4.9.2(c) Reduced River-Tunnel Alternative

The visual impacts of the Reduced River-Tunnel Alternative improve on the overall appearances of Scheme Z. Impacts of the above ground elements of this alternative are comparable to Alternative 8.1D Mod 5 while underground element impacts are reduced due to less tunnel than with 8.1D Mod 5. The view of the Project from the surrounding area also improves on the appearance of the existing area.

View Of And From The Road.

Viaducts: The Reduced River-Tunnel Alternative has 12 lanes of traffic on a single bridge structure crossing the Charles River, approximately 230 feet in width including gaps between the main line structure and the cantilevered lanes. There are no piers in the water. Four lanes in two loop ramps carry traffic between City Square and I-93. Two lanes of traffic (Ramps N-S and S-N) on one loop ramp connect Storrow Drive to I-93 northbound and southbound. One long-span bridge is supported by two diamond shape towers, approximately 310 feet high, located on the north and south banks. There are approximately 6,300 lf of tunnels through river and land. the longest section of tunnel is approximately 3,750 lf (to City Square and I-93 northbound).

Surface Roads: In the Martha Road/Lomasney Way corridor, Martha Road retains its existing appearance. At Leverett Circle and Lomasney Way/Nashua Street the corridor includes a more complex intersection of arterial roads and driveways than in Scheme Z; and has more tunnel. The 210-foot-wide corridor has more Project-related viaducts, tunnels, and transitional surface roads than Scheme Z, in addition to the MBTA Green Line. It is less likely than Scheme Z to warrant a pedestrian amenity except at areas that front buildings, or where tunnel egress stairs are required. The surface roads provide strong orientation to the surrounding neighborhoods.

The service roads connecting to Rutherford Avenue occur in an existing industrial area which they generally enhance with landscape design; except at the Millers River, which is partially filled to support surface roads.

Tunnels: The visual experience travelling to Charlestown includes some 500 feet in boat section prior to entering the new CANA ramps. Motorists view the tunnel interior followed by orientation with the visible surroundings of the north bank, prior to the CANA ramp in tunnel. Motorists travelling north on I-93 experience a gradually ascending path from the tunnel under the Charles River to viaduct. At tunnel curves, sight shelves enable views of traffic ahead. The surfaces of the tunnel, lighting, and signs are designed primarily to facilitate driver safety and comfort. The highway and highway elements inside the tunnel are compatible with highway elements of the surrounding areas.

Waterways. As proposed in the MDC parkland master plan, the Charles River has a reconfigured shoreline. This allows the bridge piers to have a foundation on the north bank, which narrows the Charles River at this point. There are no adverse visual impacts on the water environment due to viaduct piers. The I-93 bridge passes between 23 and 65 feet above the Charles River, casting shadows on the water. It is physically grouped into northbound and southbound lanes, separated by 4 feet. Ramps SA-CN and N-S are also separated east and west of I-93, by 10 feet. The shadows of the elevated viaduct are separated by daylight into four sections. This improves the visual experience of the water environment below. The separated lanes of I-93 have a regular and systematic design of highway elements, including the viaduct underdeck, which also enhances views from the water environment.

Parkland. This alternative has four fewer lanes on viaduct than Scheme Z and its piers have manageable impacts on the parkland. Viewed from the highway, the parkland is not hidden from view. It may be necessary to locate tunnel egress stair headhouses in the parkland.

Pedestrians on the north bank have views between North Point and Paul Revere Landing Park North, which, due to consistent profiles of loop ramps, is similar to Alternative 8.1D Mod 5. The proposed parkland and sculpted shoreline, however, add a pedestrian scale and facility to this environment, including a public interest attraction at the bridge piers. Pedestrians on the south bank have views between the MBTA railroad tracks and Lovejoy Wharf. A remodeled shoreline adds bridge abutment

architecture to their view. The separation of I-93 from Ramps S-N/N-S on the west creates two distinctive visual zones.

Project-Related Buildings. The tunnels in this alternative require one ventilation building on each side of the Charles River. Tunnel egress stair headhouses are also required.

The ventilation building on the south bank is built below ground except for an air-intake shaft and three exhaust-air discharge stacks. These have a visual presence due to their height when viewed from the area of the Charles River crossing. Views from the high-rise buildings on the south are partially interrupted by the stacks.

The top of ventilation building 9 is 60 feet above ground, with two exhaust-air discharge stacks, alongside I-93. The building is separated from the parkland by Ramp T-C among other industrial land uses. Ventilation building 9 is built on the north bank, alongside but lower than I-93. It is designed to complement the orientation of motorists, especially those travelling southbound. It has exhaust-air discharge stacks above the deck of I-93, which are visible from most areas of the Charles River parkland. The tunnel egress stair headhouses are being designed to respond to the recreational activity of the park. The opportunities to incorporate these structures into recreational uses in the park are being studied.

4.9.2(d) Non-River-Tunnel Alternative

The visual impacts of viaducts in this alternative are lessened by the separation of the two bridges. This reduces shadows on the parkland, and visually separates the cable-stayed bridge from the viaduct as two structural systems allowing the bridge to stand alone, relatively uncluttered. In other areas, appearances are similar to those described for the Reduced River-Tunnel Alternative, without the added impacts of a tunnel journey. The parkland areas are enlivened by implementation of the proposed MDC parkland master plan.

View Of And From The Road. The Non River-Tunnel Alternative has 14 lanes of traffic on viaducts crossing the Charles River, approximately 330 feet in width including a 100-foot gap between the mainline bridge and the bridge carrying Storrow Drive connections. Five lanes of traffic on three loop ramps carry traffic between City Square and I-93. Four lanes in two loop ramps (Ramps N-S and S-N) connect Storrow Drive to I-93 northbound and southbound.

This alternative has one 10-lane long-span bridge supported by two diamond shape towers, approximately 310 feet high on both north and south banks. A second 4-lane medium span parallel to the mainline bridge is supported by four piers in the water. There are approximately 2,850 lf of land-based tunnels on the south bank of the Charles River.

Viaducts: Views are possible along the Charles River, and northeast and northwest to Charlestown and Somerville. The Storrow connector viaduct, which is approximately 100 feet west of I-93 and similar in profile, is not as high as the two-tier Scheme Z. The elevated views for motorists from it are wide, with less interruption from other viaducts and viaduct structures than in Scheme Z. Viaduct underdecks are visible to motorists and to park users, and their design is visually consistent with the highway and the highway elements.

This alternative has less than half the number of loop ramps than Scheme Z. Their impact, however, is reduced by their lower height, simpler pier design, and overall coordination as concentric ramps at approximately the same profile. In addition, the loop ramps maintain a 100-foot setback from the Charles River. In the area adjacent to North Point they are not as complex as the multilevel ramps of Scheme

Z. They are designed so as not to detract the visual environment of North Point, the parkland, and views from surrounding neighborhoods.

Surface Roads: In the Martha Road/Lomasney Way corridor, Martha Road retains its existing appearance. At Leverett Circle and Lomasney Way/Nashua Street, the corridor includes intersections of arterial roads and driveways in a more complex arrangement than in Scheme Z. Surface roads in this 210-foot corridor are improved in appearance by landscaping, providing both driver and pedestrian orientation.

Service roads connecting to Rutherford Avenue occur mostly in an existing industrial area. In order to reach BSG, they cross over and partially fill the Millers River. Through landscape design, they are substantially screened from Rutherford Avenue and the proposed park.

Tunnels: Three routes in addition to one existing route beneath Leverett Circle are all located on the south bank in the passage to and from I-93 downtown and Storow Drive. These tunnels separate at Ramp CN-L which is combined with a turning curve and incline to Nashua Street. Particular design attention is given to the placement and design of signs and highway elements to maximize views of the road ahead, and to coordinate with other tunnel elements.

Waterways. The proposed MDC parkland master plan for the Charles River anticipates a reconfigured shoreline. It is changed to allow a foundation for the bridge piers on the riverbank, making the Charles River visibly narrower at this point. The river has a 336-foot viaduct corridor above, casting shadows on the river, although permitting light to penetrate an approximately 100-foot-wide gap between the mainline and supplemental bridge structure. This effectively comprises two distinct bridges, and makes the visual impact on the water environment minor in comparison to Scheme Z.

Parkland. The structural impacts of the viaducts and viaduct piers are compatible with the highway environment, with the added screen and buffer of the parkland. Viewed from the highway, only some sections of parkland under I-93 are momentarily hidden from view. No tunnel egress stair enclosures are located in the proposed parkland.

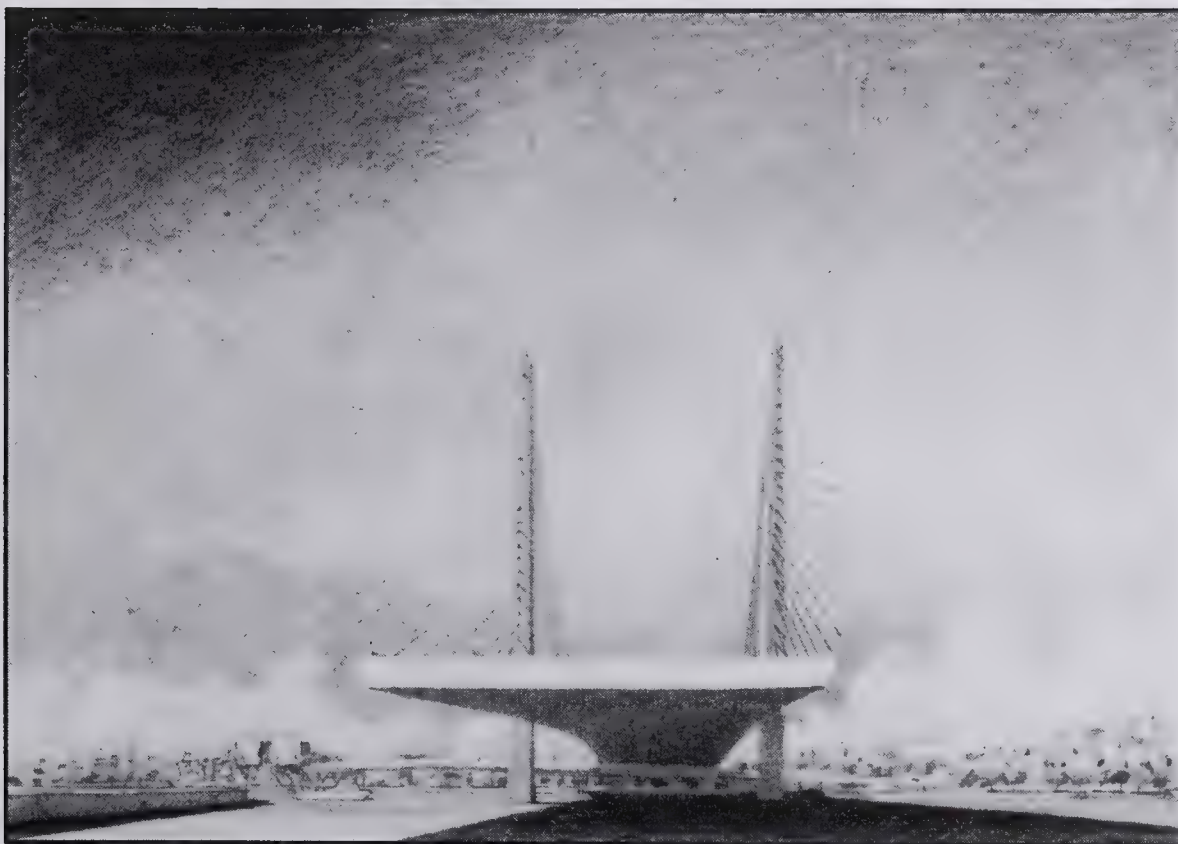
Pedestrians on the north bank capture views between the historic railroad Tower A and Paul Revere Landing Park North along the shoreline. This is separated into two visual zones by the overhead separation of main line and supplemental bridges. The shadows of the viaduct are separated by sunlight through the gaps. Pedestrians on the south bank have uninterrupted passage under I-93. A remodeled shoreline combines parkland views with the architecture of the bridge abutment. As with the north bank, the south bank benefits from the separation.

Project-Related Buildings. This alternative has one ventilation building on the south bank. It is built below ground except for an air-intake structure and three air-exhaust discharge stacks, and is surrounded by a joint development parcel (see Section 4.2, Joint Development Impacts). Only the tops of the stacks are visible after the surrounding buildings are developed. They cause only a minor addition to the skyline created by other structures at this height.

Three tunnel egress stair headhouses are required for the tunnels on the south bank. These are integrated with other proposed parkland uses.



Scheme Z



Alternative 8.1D Mod 5

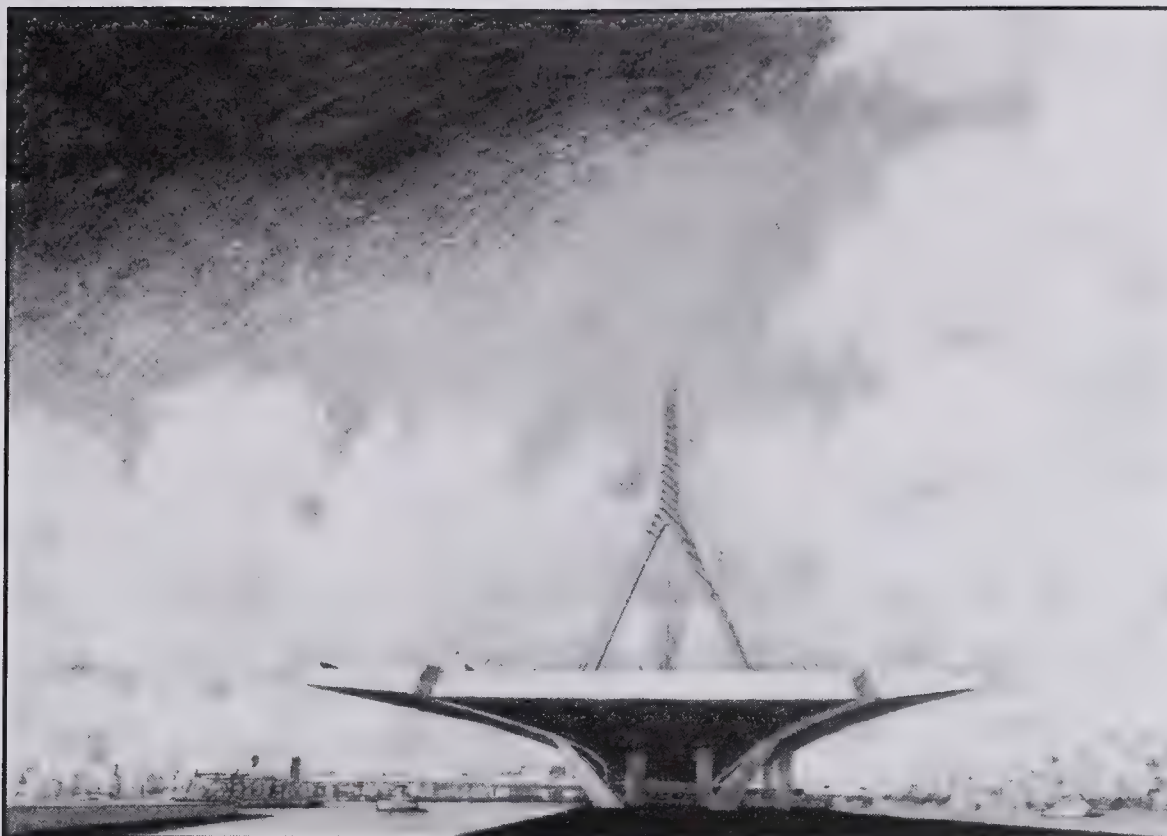
FIGURE

4.46

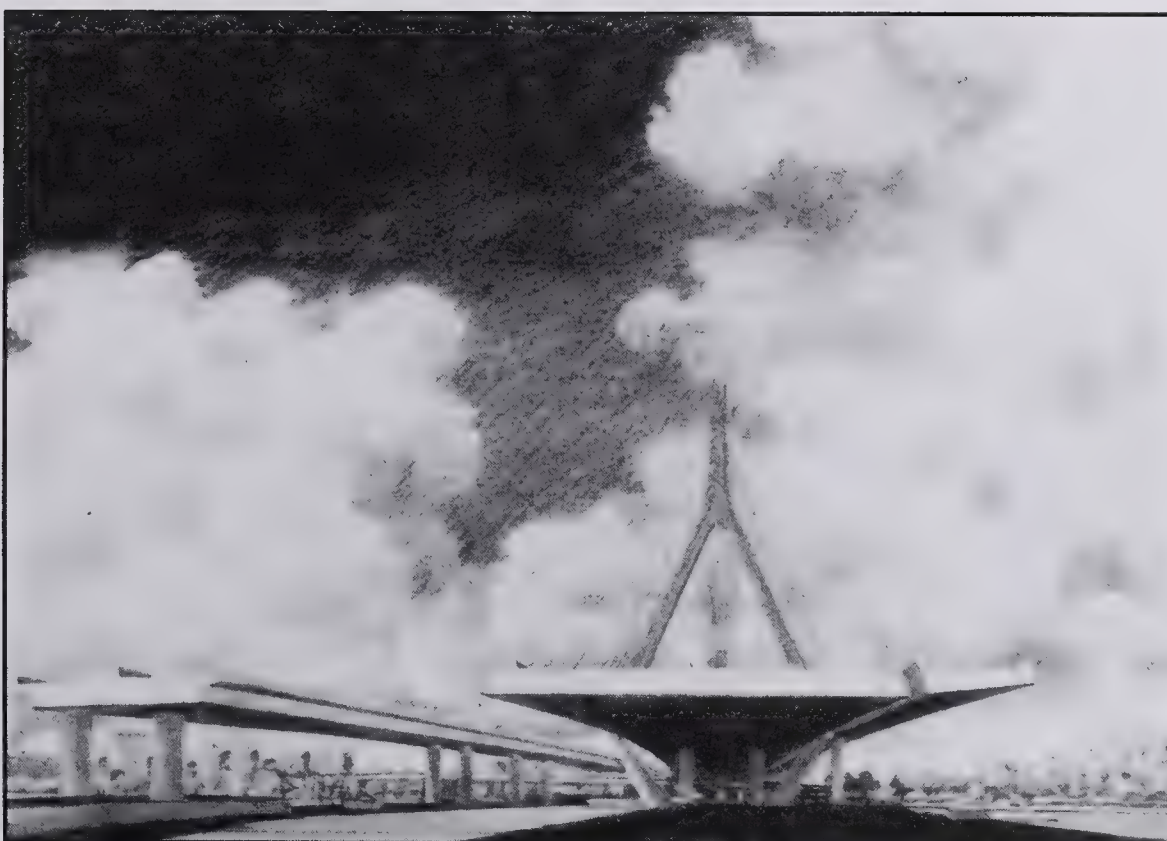
Sectional View Looking North
From South Bank: Scheme Z And
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Reduced River-Tunnel Alternative



Non-River -Tunnel Alternative

FIGURE

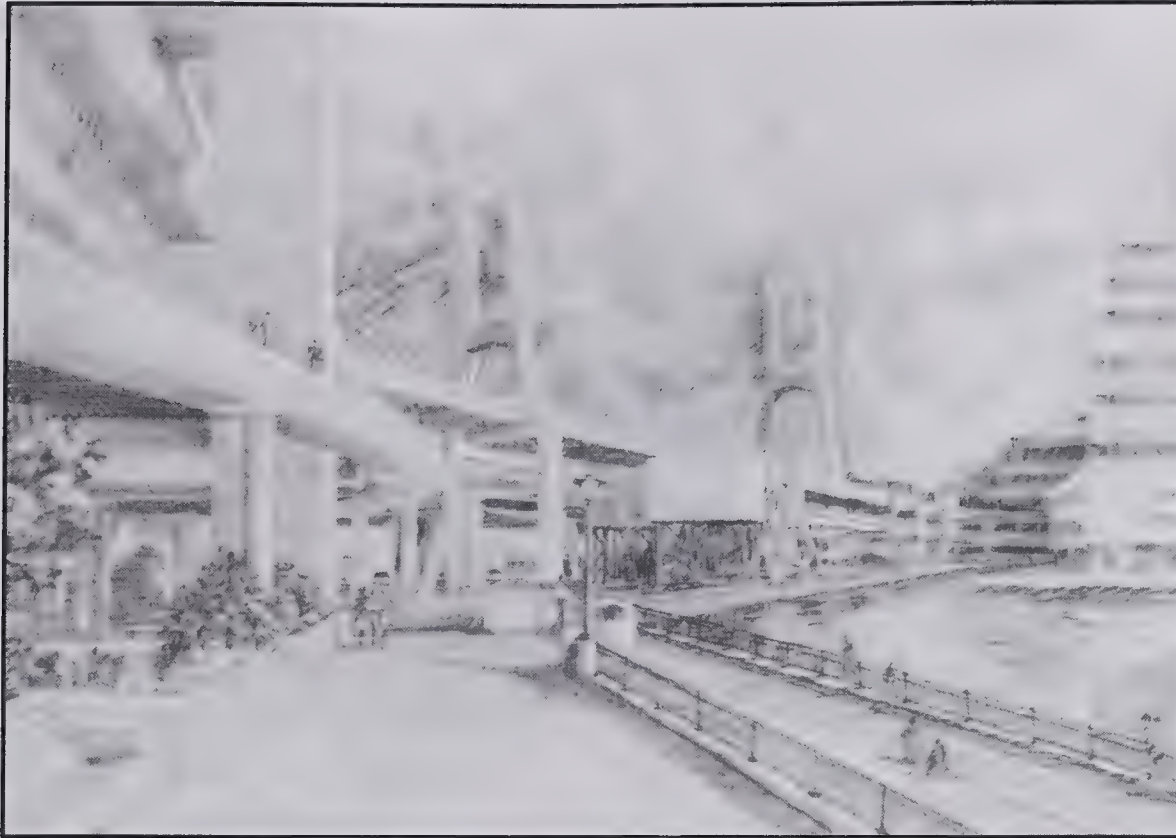
4.47

**Sectional View Looking North From
South Bank: Reduced River-Tunnel
And Non-River-Tunnel Alternatives**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





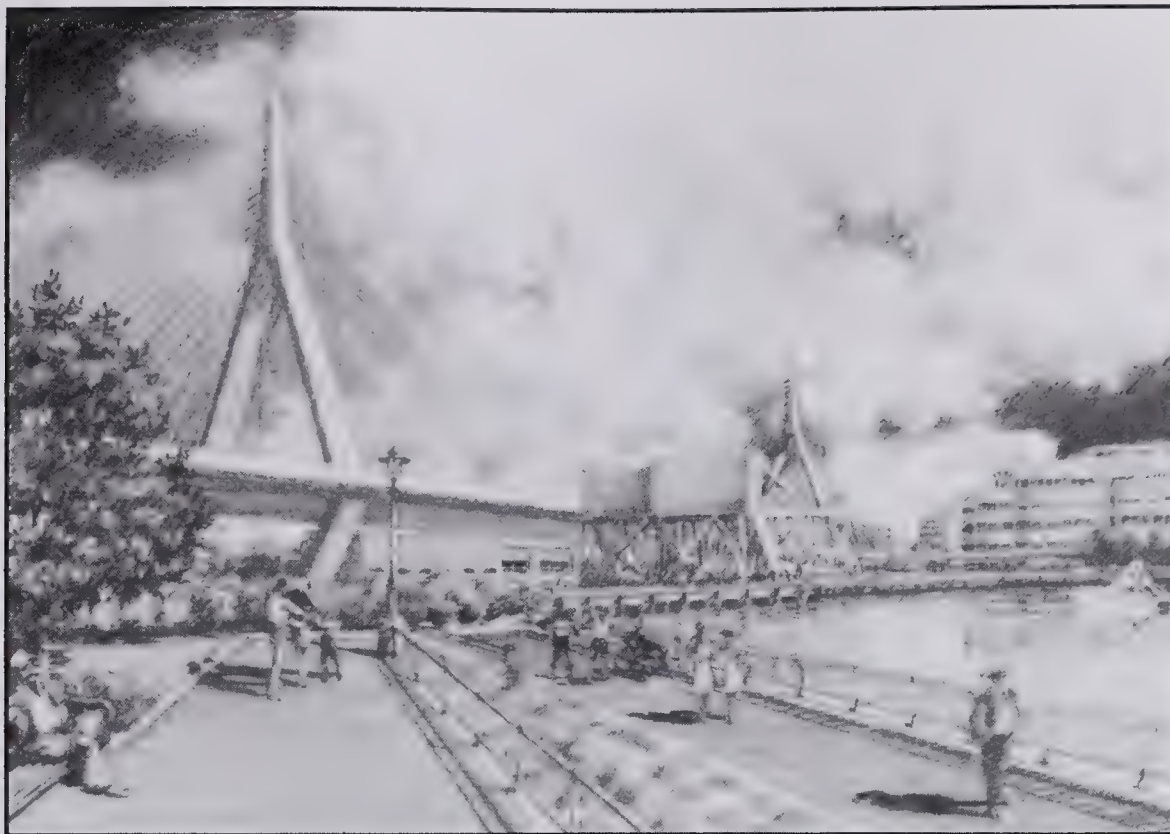


Scheme Z

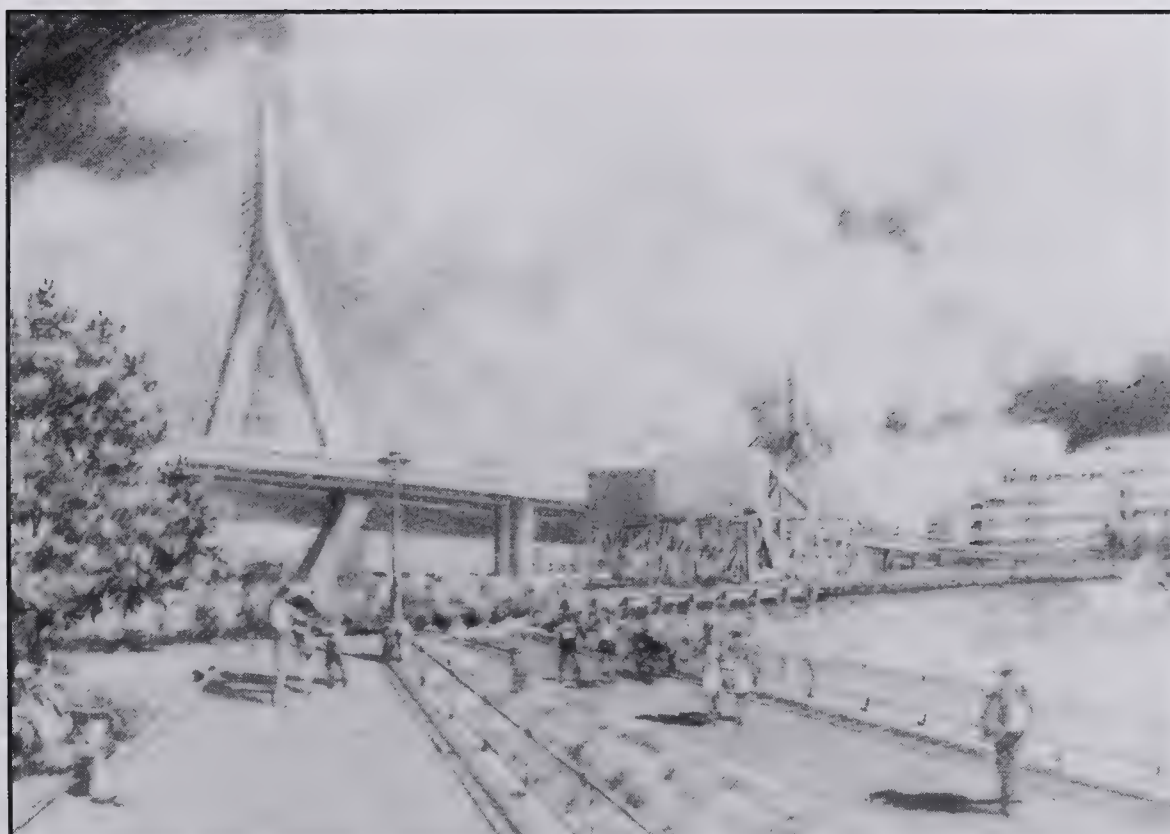


Alternative 8.1D Mod 5

FIGURE 4.48	View Of Charles River Bridge From North Bank Looking East: Scheme Z and Alternative 8.1D Mod 5 Charles River Crossing DSEIS/R	MASSACHUSETTS HIGHWAY DEPARTMENT CENTRAL ARTERY/TUNNEL PROJECT	
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Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

FIGURE

4.49

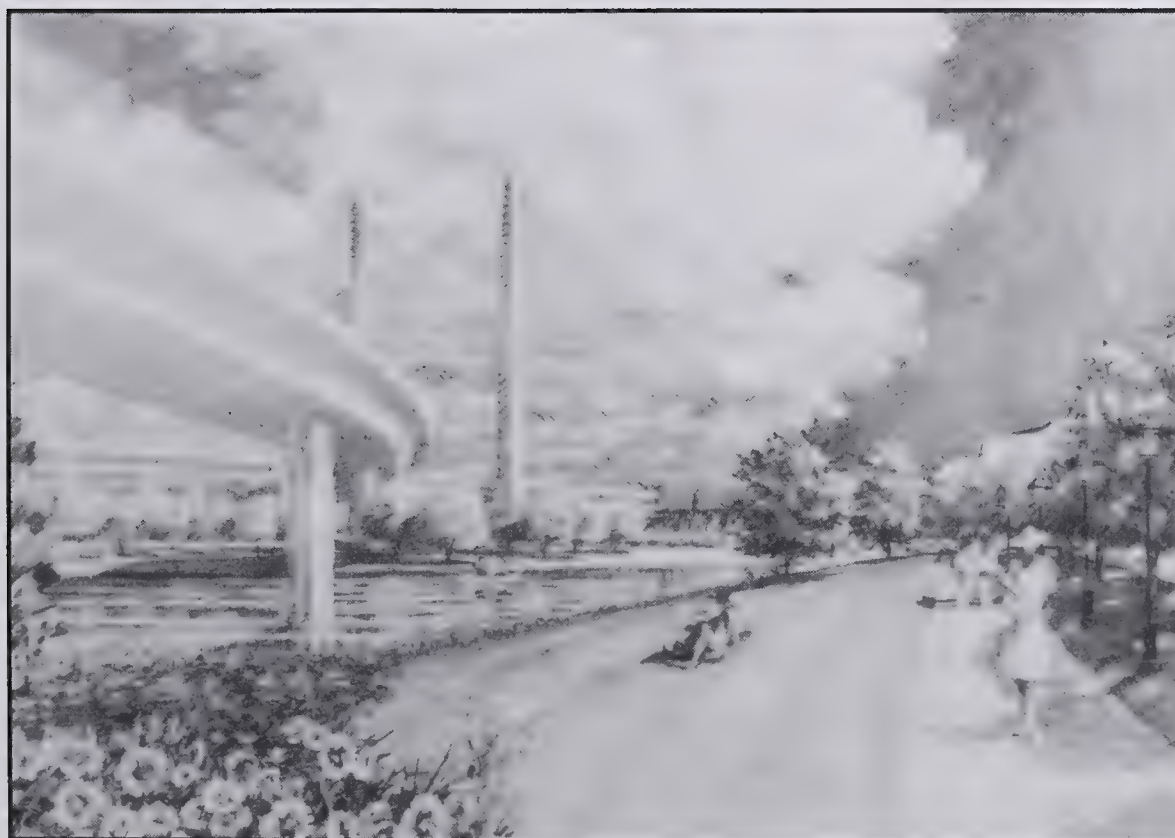
View Of Charles River Bridge From
North Bank Looking East: Reduced River-
Tunnel And Non-River-Tunnel Alternatives
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Scheme Z



Alternative 8.1D Mod 5

FIGURE 4.50	View of Charles River Loop Ramps And Bridge From Cambridge: Scheme Z And Alternative 8.1D Mod 5 Charles River Crossing DSEIS/R	MASSACHUSETTS HIGHWAY DEPARTMENT CENTRAL ARTERY/TUNNEL PROJECT	
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Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

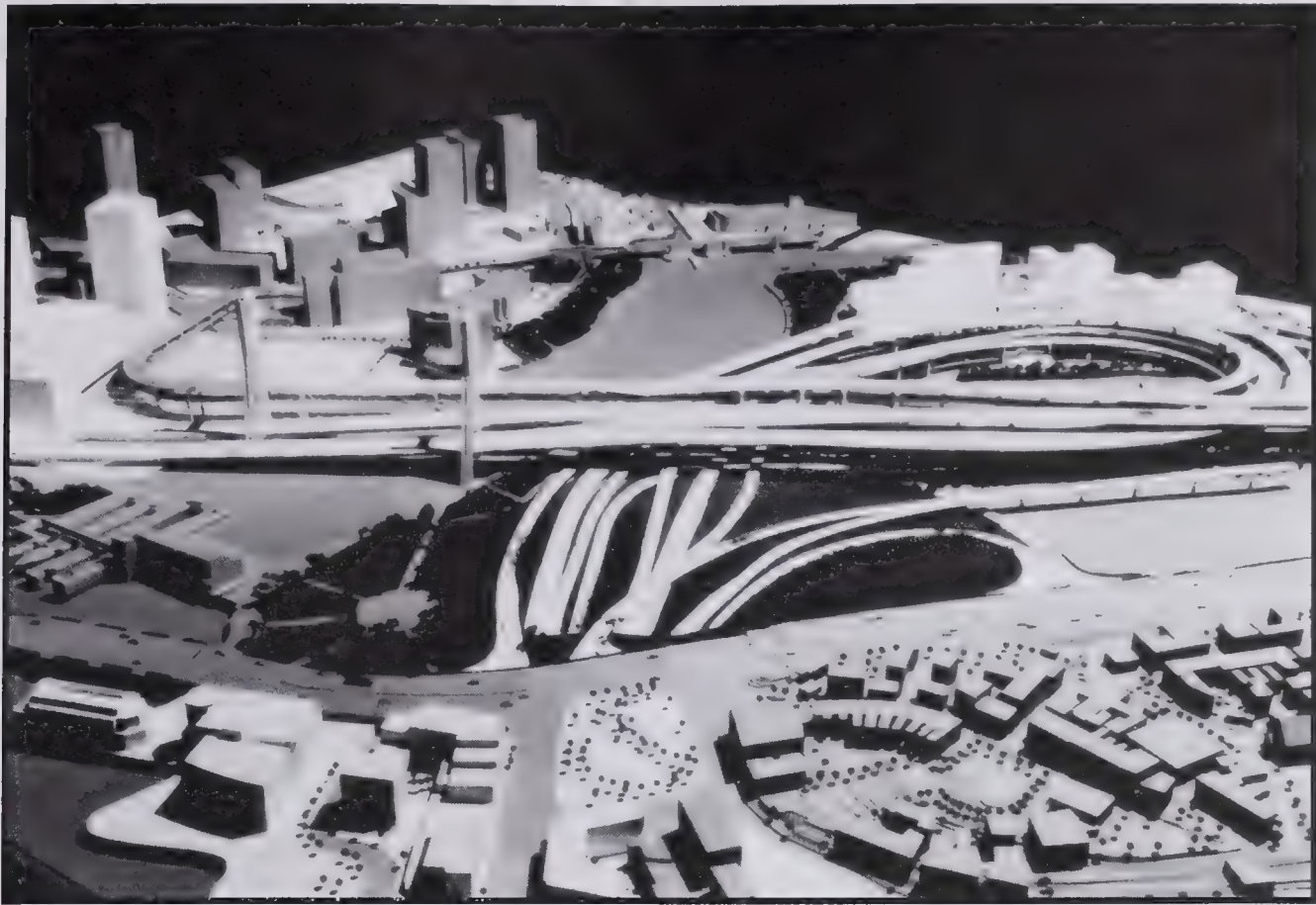
FIGURE

4.51

View Of Charles River Loop Ramps And
Bridge From Cambridge: Reduced River-
Tunnel And Non-River-Tunnel Alternatives
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Scheme Z



Alternative 8.1D Mod 5

Note: Landscape treatment in Alternative 8.1D Mod 5 is based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

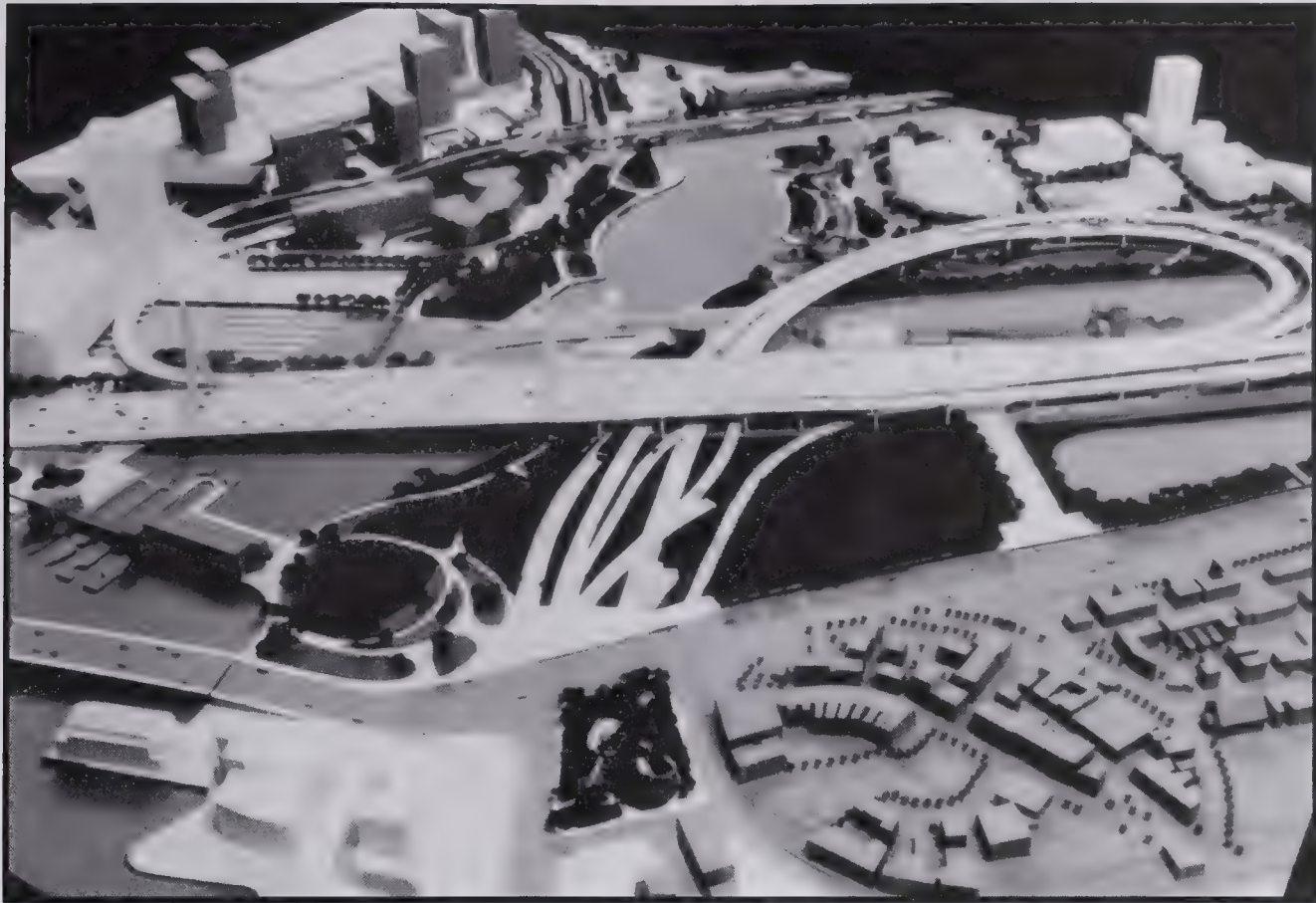
FIGURE

4.52

**View Of Model From East
Looking West: Scheme Z
And Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

Note: Landscape treatments in Reduced River-Tunnel and Non-River-Tunnel Alternatives are based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

FIGURE

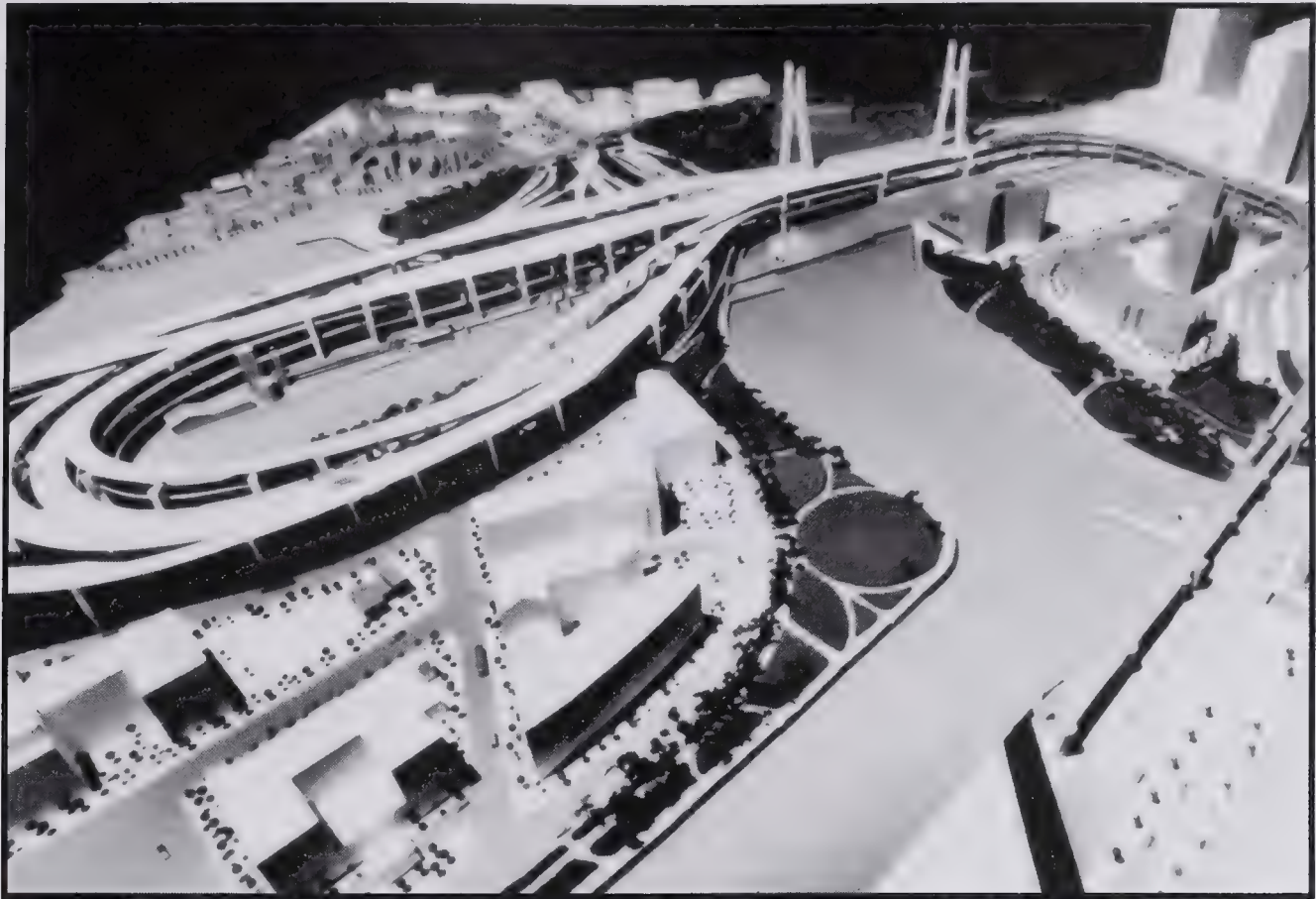
4.53

**View Of Model From East
Looking West: Reduced River-Tunnel
And Non-River-Tunnel Alternatives**

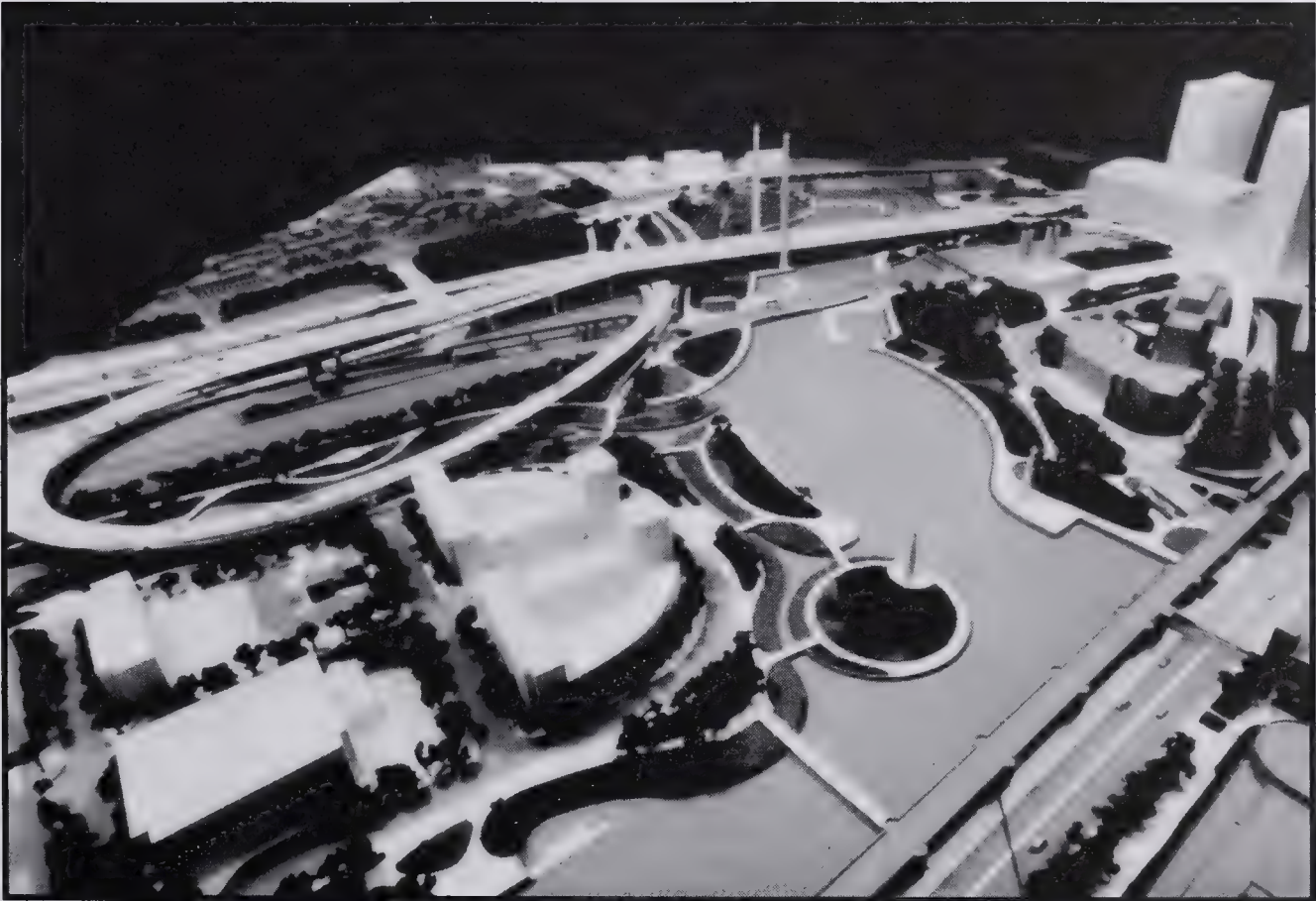
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Scheme Z



Alternative 8.1D Mod 5

Note: Landscape treatment in Alternative 8.1D Mod 5 is based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.



Reduced River-Tunnel Alternative



Non-River Tunnel Alternative

Note: Landscape treatments in Reduced River-Tunnel and Non-River-Tunnel Alternatives are based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

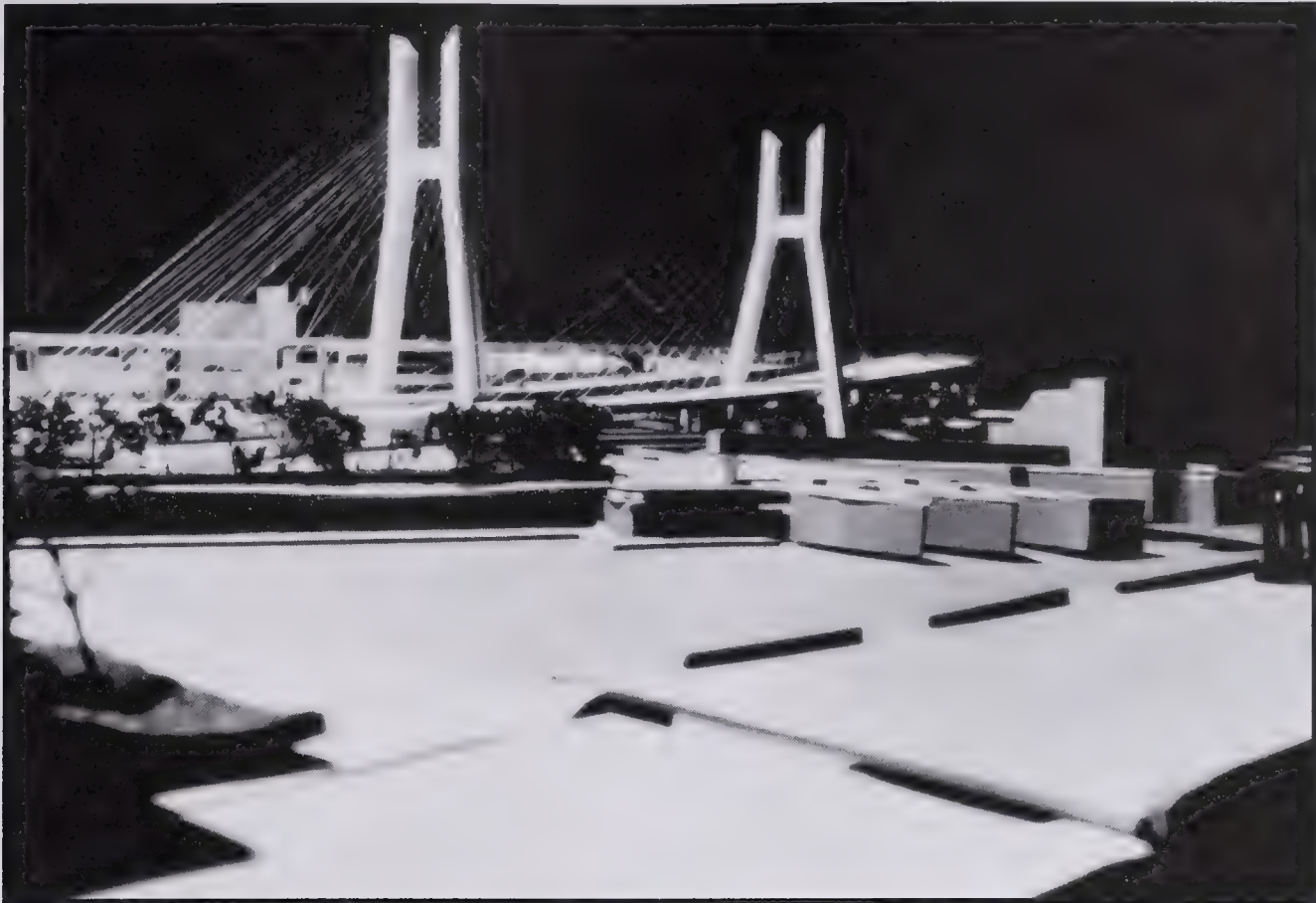
FIGURE

4.55

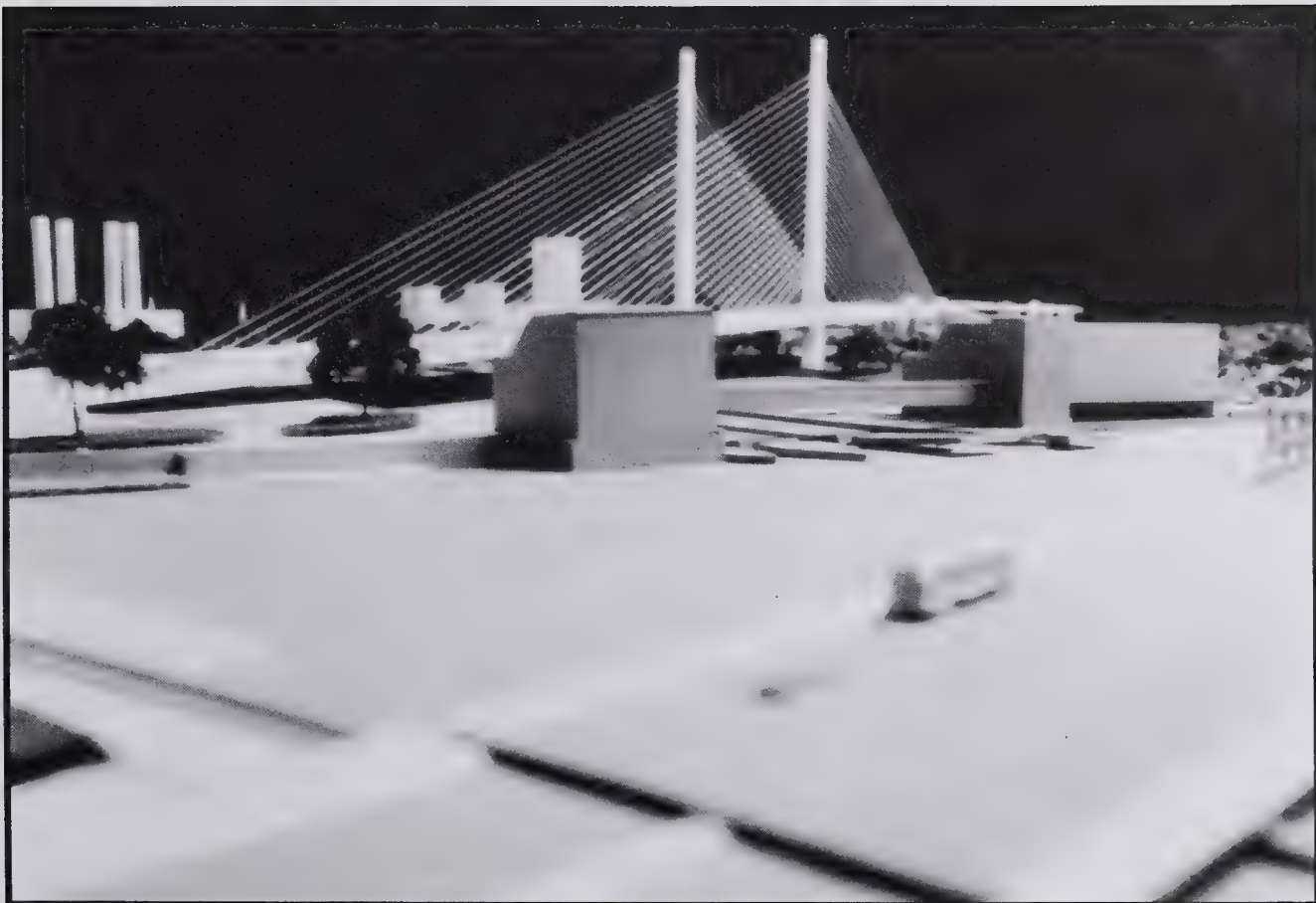
**View Of Model From West
Looking East: Reduced River-Tunnel
And Non-River Tunnel Alternatives**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Scheme Z



Alternative 8.1D Mod 5

Note: Landscape treatment in Alternative 8.1D Mod 5 is based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

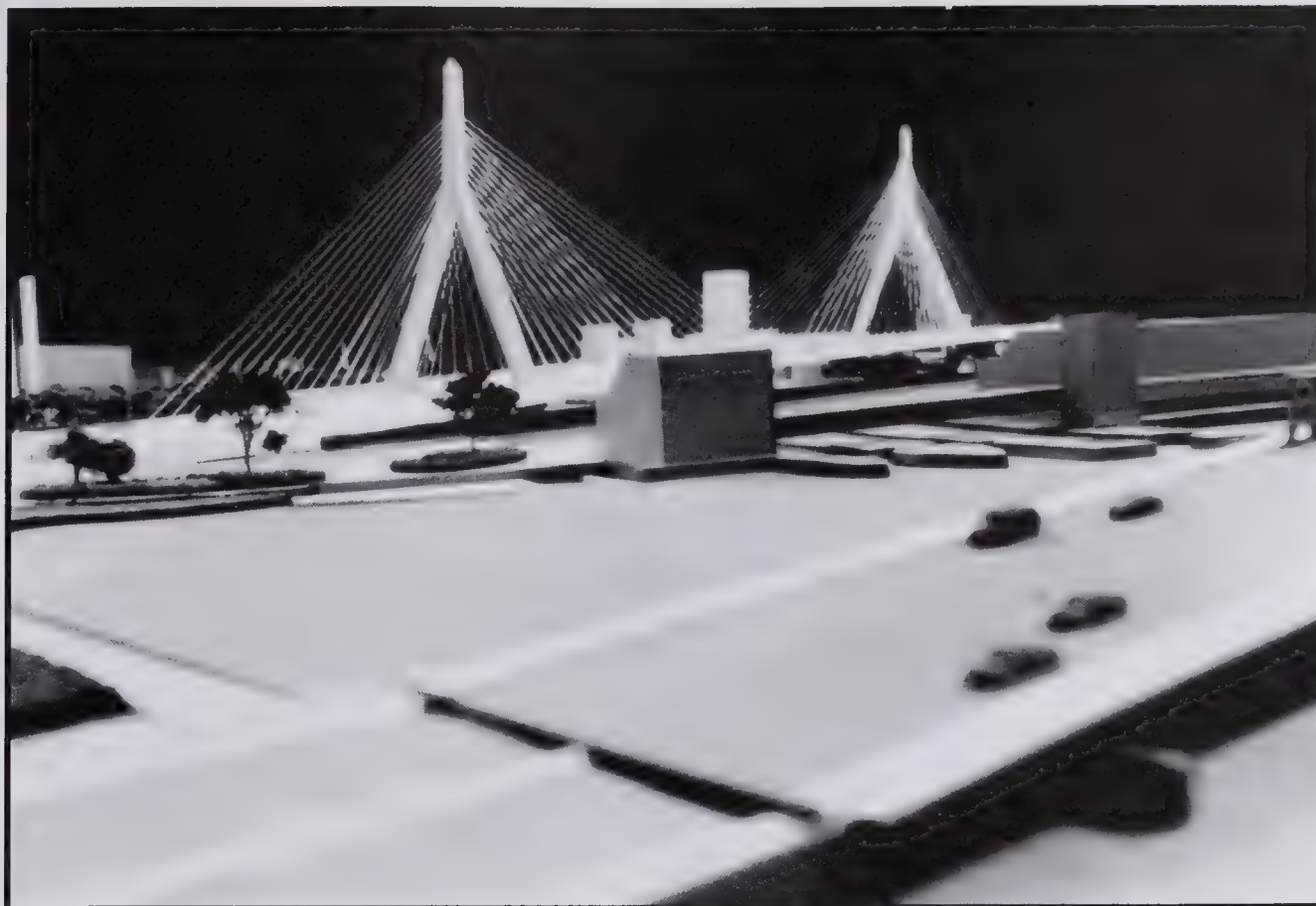
FIGURE

4.56

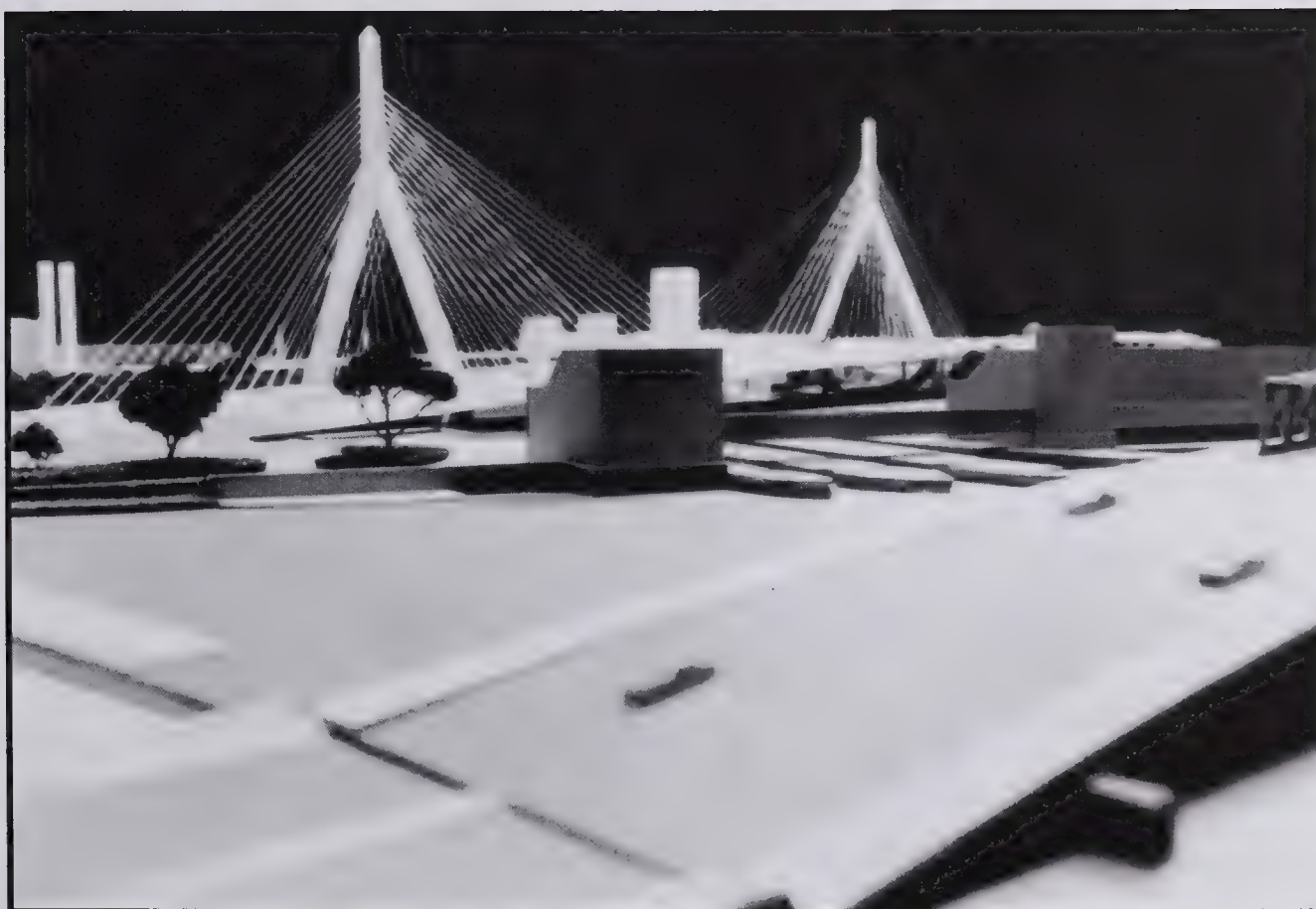
**View Of Model From North
Washington Street Bridge:
Scheme Z And Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Reduced-River-Tunnel Alternative



Non-River Tunnel Alternative

Note: Landscape treatments in Reduced River-Tunnel and Non-River-Tunnel Alternatives are based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

FIGURE

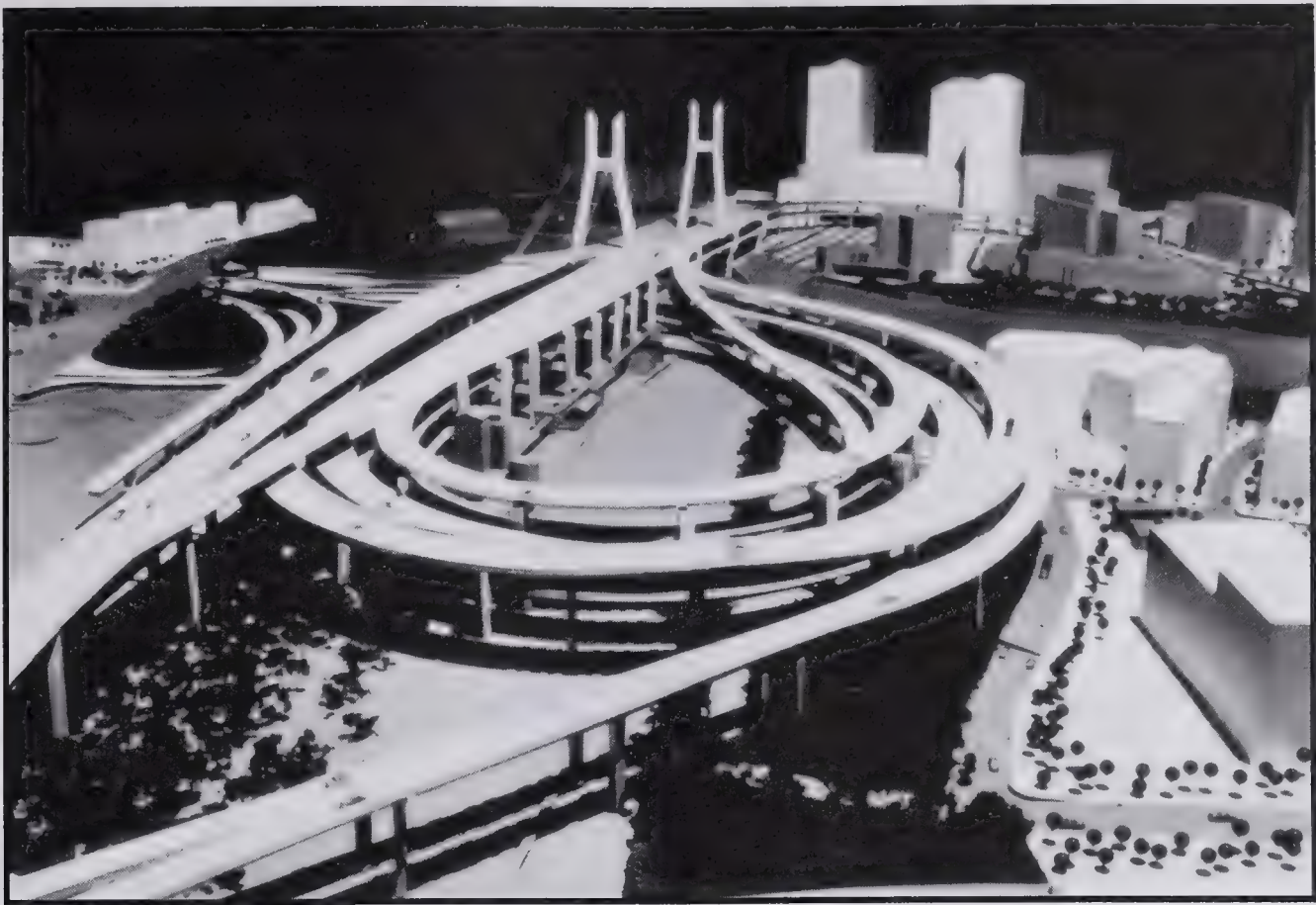
4.57

View Of Model From North Washington Street Bridge: Reduced River-Tunnel And Non-River-Tunnel Alternatives

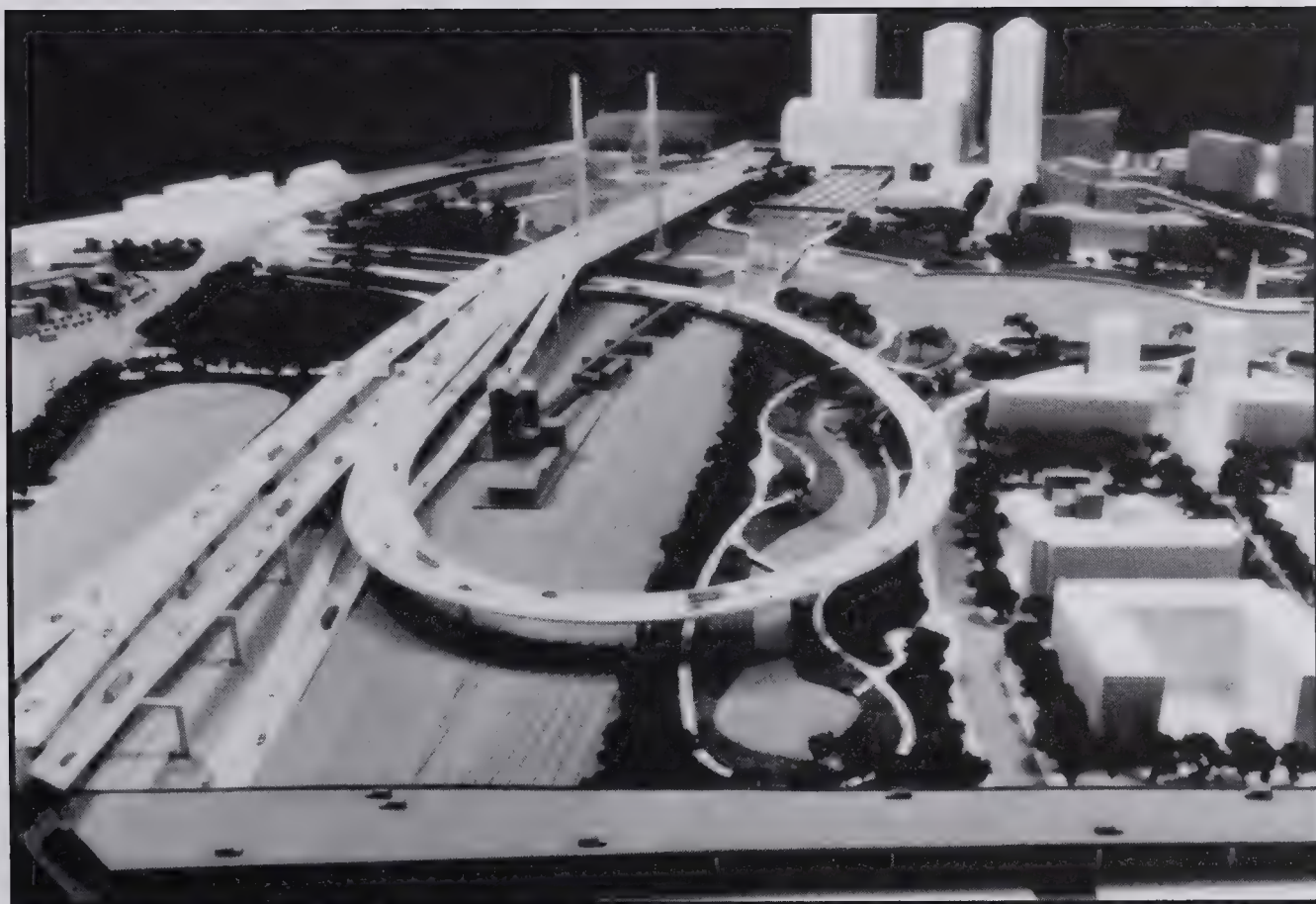
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Scheme Z



Alternative 8.1D Mod 5

Note: Landscape treatment in Alternative 8.1D Mod 5 is based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

FIGURE

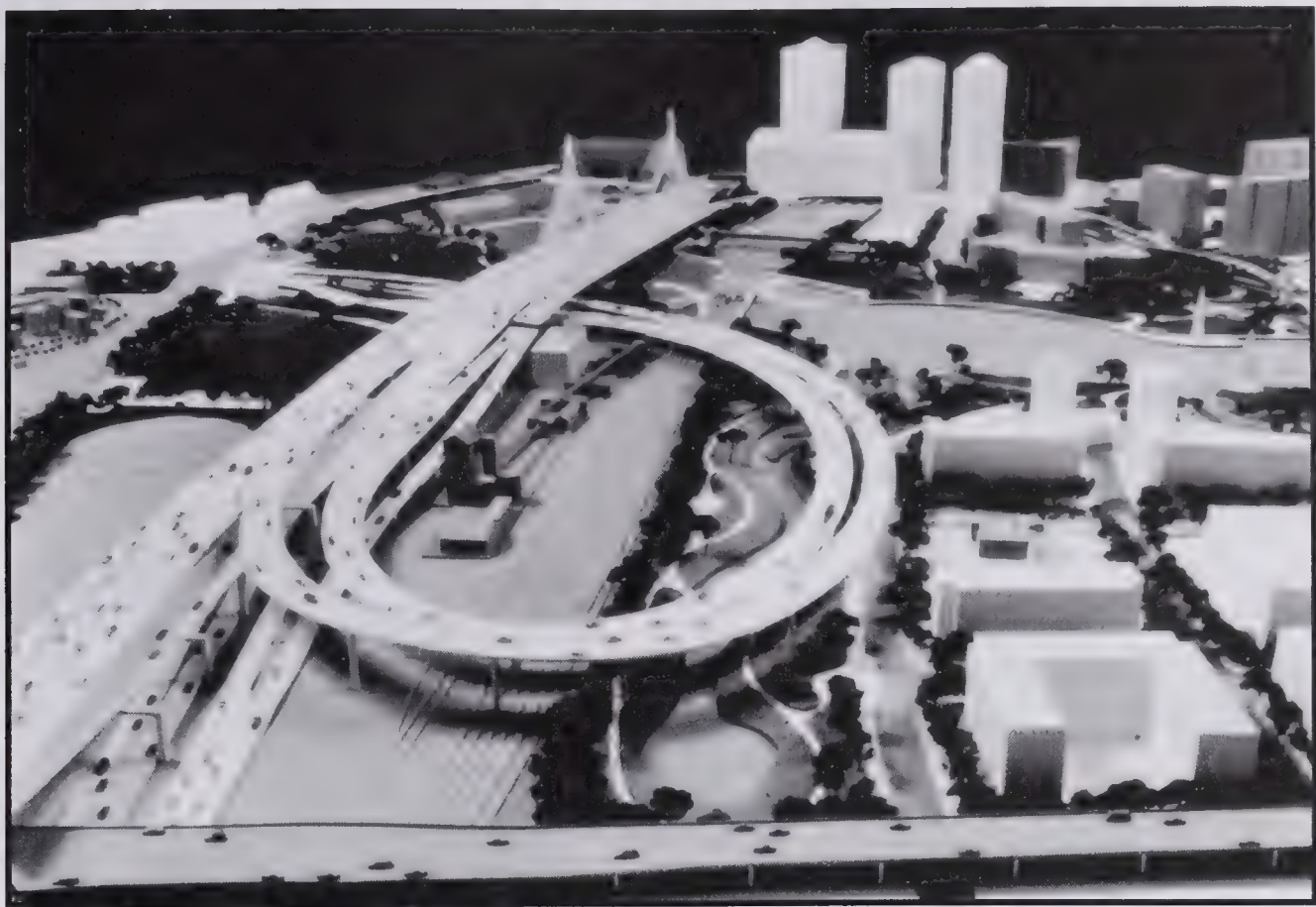
4.58

**View Of Model From North
Looking South: Scheme Z
And Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

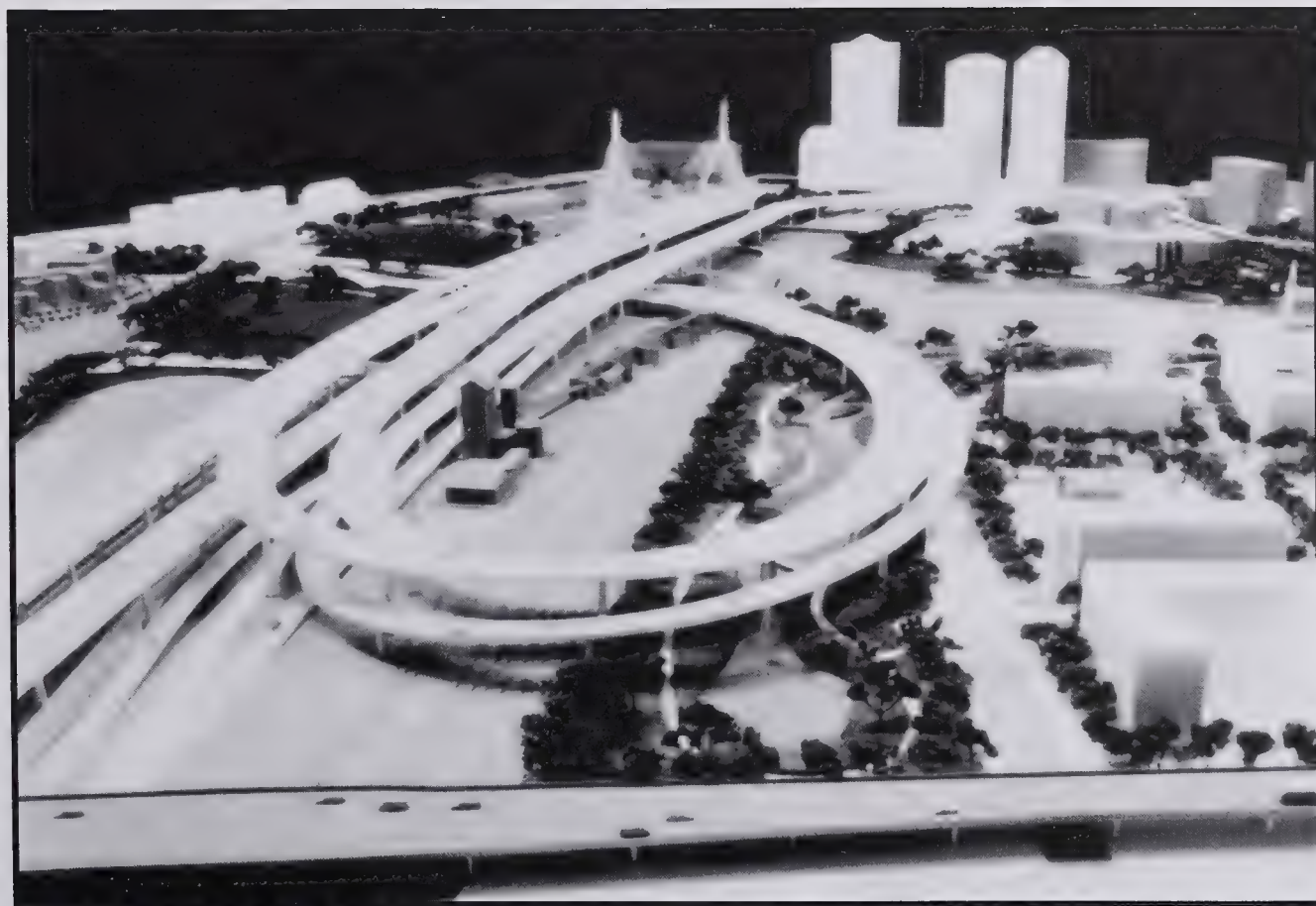
MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT







Reduced River-Tunnel Alternative



Non-River Tunnel Alternative

Note: Landscape treatments in Reduced River-Tunnel and Non-River-Tunnel Alternatives are based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

FIGURE

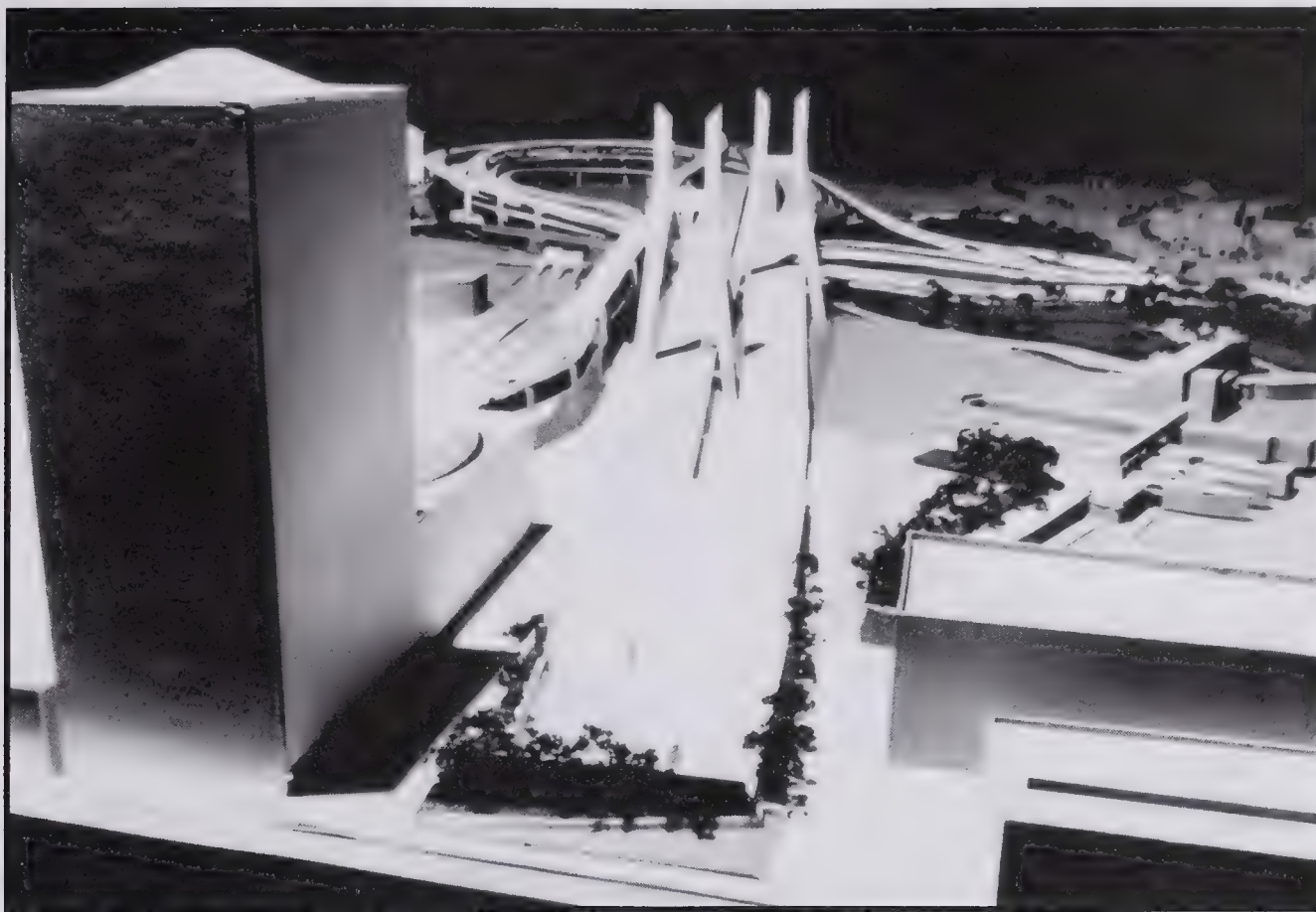
4.59

**View Of Model From North
Looking South: Reduced River-Tunnel
And Non-River-Tunnel Alternatives**

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Scheme Z



Alternative 8.1D Mod 5

Note: Landscape treatment in Alternative 8.1D Mod 5 is based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

FIGURE

4.60

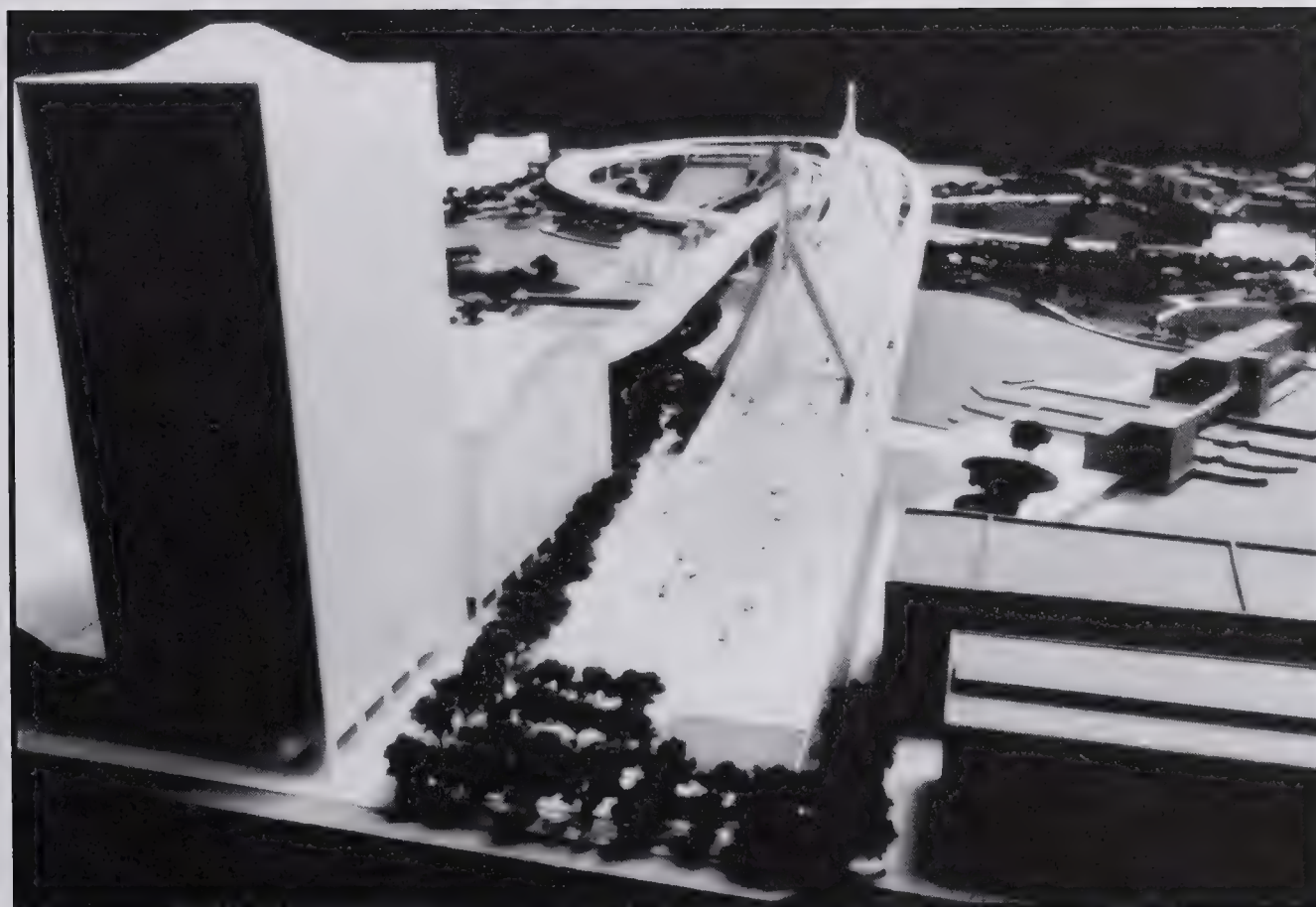
**View Of Model From South
Looking North: Scheme Z
And Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

Note: Landscape treatments in Reduced River-Tunnel and Non-River-Tunnel Alternatives are based upon MDC Masterplan proposals rather than project mitigation measures and are illustrative only.

FIGURE

4.61

**View Of Model From South
Looking North: Reduced River-Tunnel
And Non-River-Tunnel Alternatives**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



COMPARISON OF VISUAL IMPACTS BY ALTERNATIVE

	Scheme Z	Alternatives Compared to Scheme Z		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
Viaducts	<i>Adverse Impact</i> Sixteen-lane bridge crossing. Complex multilevel loop ramps. Two-tier 6-lane viaducts at North Station area. Interruption of views.	<i>Minimal Impact</i> Ten-lane bridge crossing. One loop ramp. One two lane viaduct at North Station area.	<i>Moderate Impact</i> Twelve-lane bridge crossing. Two loop ramps. One two lane viaduct at North Station area.	<i>Moderate Impact</i> Fourteen-lane bridge crossing. Two to three loop ramps. One four-lane viaduct at North Station area.
Surface environment	<i>Adverse Impact</i> Major encroachment on riverbank and North Point. MDC parkland plan accommodated.	<i>Moderate Impact</i> Proposed MDC parkland plan accommodated. Lomasney Way corridor is adversely affected. Large ventilation building at Spaulding site.	<i>Moderate Impact</i> Proposed MDC parkland plan accommodated. Lomasney Way corridor is adversely affected. Two smaller ventilation buildings (below ground on south bank; above ground on north bank; above ground stacks).	<i>Moderate Impact</i> Proposed MDC parkland plan accommodated. Lomasney Way corridor adversely affected. One below ground ventilation building on south bank with above ground stacks. Realigned Nashua Street.
Tunnel environment	<i>No Impact</i> Short underpass at Leverett Circle only.	<i>Adverse Impact</i> Extensive and complex tunnel system (curves, grades and decision points numerous).	<i>Moderate Impact</i> Simpler tunnel system.	<i>Minimal Impact</i> Least complex tunnel system.
Water environment (# piers in Charles reflects existing shoreline; not sculpted shoreline in proposed MDC master plan)	<i>Adverse Impact</i> 11 piers in Charles. 8 piers in Millers. Interruption of visual navigation. Major shadowing effects of bridge structure.	<i>Minimal Impact</i> One pier in Charles. 8 piers in Millers. Minimal shadowing effects of narrower bridge structure.	<i>Minimal Impact</i> One pier in Charles. 9 piers in Millers. Some shadow impacts due to bridge structure.	<i>Moderate Impact</i> 6 piers in Charles. 8 piers in Millers. Moderate shadow impacts due to two separate bridge structures.

Source: Bechtel/Parsons Brinckerhoff

4.9.3 Mitigation And Enhancement Measures

In order to mitigate negative and to maximize positive visual impacts, efforts will be made to integrate the following measures into all four designs:

- Provide for compatibility of all elements of the highway with the proposed parkland, with the objective of fostering recreational uses and minimizing acoustic and shadow impacts of the highway.
- Provide for compatibility between Project-related buildings and necessary surface roads and open space to provide a visually cohesive urban environment.
- Integrate public art with the Project structures, buildings, and parkland through the Artery Arts Program to enhance Project elements and make viable community spaces.
- Design a high-quality bridge(s) that is in keeping with its prominent location, framing entrances to and from Boston and the Charles River Basin. Make certain that the bridge design provides an acceptable balance of safety, economy, constructibility, and aesthetics.
- Design landscape and architectural elements in a broad urban framework to screen undesirable views, to provide a coherent visual environment, and to make visual connections with the surroundings.
- Design and locate Project buildings so that they are suited to their use and compatible with surrounding neighborhood activity to the extent possible.

4.10 ENERGY

4.10.1 Introduction

This section quantifies the direct and indirect energy expenditures associated with the three new design alternatives. Direct energy involves all energy consumed by vehicle propulsion and the amount of electricity used for tunnel ventilation and lighting. Indirect consumption involves the one-time expenditure of energy required for constructing the Project. This analysis estimates projected energy consumption in the year 2010 for the three new design alternatives, and compares those figures with anticipated consumption levels for Scheme Z.

4.10.2 Impacts

4.10.2(a) Direct Energy Analysis

Fuel Consumption. Fuel consumption by vehicle is calculated based on Project traffic data on vehicle miles travelled (VMT) and average travel speeds, together with speed-sensitive fuel consumption formulae presented in FHWA-TSA-81-210, *A Method For Estimating Fuel Consumption and Vehicle Emission On Urban Arterials And Networks*.

Table 4.43 provides estimates of total VMT and annual fuel consumption for Scheme Z and the three new design alternatives. Because of its higher VMT figure, fuel consumption is projected to be highest under Scheme Z, at 13.4×10^{12} Btus. Of the three new design alternatives under consideration, Alternative 8.1D Mod 5 results in the greatest savings in fuel consumption from Scheme Z (2.05 percent), followed

by the Reduced River Tunnel Alternative (1.28 percent), and the Non-River-Tunnel Alternative (0.85 percent).

Electrical Consumption. Annual electrical energy consumption requirements for tunnel ventilation, drainage, and roadway lighting in the Project subarea has been estimated and is summarized in Table 4.44. Scheme Z has the lowest annual energy requirement for electrical systems (11,950 Btus) because it involves the shortest distance of roadway in tunnel. Alternative 8.1D Mod 5 has the highest electrical consumption requirements at 76,540 million Btus, followed by the Reduced River-Tunnel and Non-River-Tunnel Alternatives at 37,880 and 28,330 million Btus, respectively.

Total Direct Energy Consumption. Total annual direct energy requirements are projected to be highest under Scheme Z at 2,312,220 equivalent barrels of oil. Of the three alternatives, 8.1D Mod 5 results in the lowest direct energy requirements at 2,270,100, a 1.5 percent decrease from Scheme Z. The Reduced River-Tunnel Alternative results in a 1.09 percent savings from Scheme Z, at 2,286,930 Bbl, while the Non-River-Tunnel Alternative results in a 0.73 percent savings at 2,295,310 Bbl.

4.10.2(b) Indirect Energy Analysis: Construction Energy

The analysis of construction energy quantifies and compares the amount of energy required to construct all Project infrastructure in the Area North of Causeway Street under Scheme Z and the three new design alternatives. For the purpose of this analysis, the length of all new structures associated with the different alternatives has been divided into the total number of lane miles constructed at grade, on elevated structures, in boat section and in tunnel. Construction energy requirements are then derived by multiplying these lengths by Btu per line-mile figures, which quantify the amount of energy necessary to construct various types of roadway. The construction energy requirements for the alternatives are summarized in Table 4.45. Although Scheme Z has the shortest lane-mile total in the Area North of Causeway Street, it has the highest construction energy requirement at 332,857 Bbl; because relatively little of the alignment is constructed at grade. Instead, most roadways in Scheme Z are on elevated structures, which are much more energy-intensive to build. The construction energy requirements for the three alternatives are relatively similar, ranging from a low 320,450 Bbl for the Reduced River-Tunnel Alternative to a high of 326,980 Bbl for the Non-River Tunnel Alternative.

4.10.3 Conclusion

An energy analysis indicates that Scheme Z has both the highest direct and indirect energy requirements. As a result, implementation of any of the three new design alternatives under consideration results in energy savings. The 1991 FSEIS/R concluded that the direct energy savings realized under Scheme Z when compared to a future no-build scenario compensates for construction energy requirements in approximately 7 years. Implementation of any of the three new design alternatives under consideration results in a shorter pay-back period. Of the four designs, Alternative 8.1.D Mod 5 results in the largest energy savings when compared to Scheme Z, followed closely by the Reduced River-Tunnel Alternative and the Non-River-Tunnel Alternative, respectively.

4.11 RELATIONSHIP OF LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

This chapter discusses in general terms the relationship of local short-term impacts and the use of resources and long-term productivity for Scheme Z, Alternative 8.1D Mod 5, the Reduced River-Tunnel Alternative, and the Non-River-Tunnel Alternative, respectively.

Table 4.43

**ANNUAL DIRECT ENERGY CONSUMPTION BY VEHICLES
(Year 2010)**

	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
Annual VMT (millions)	2,011	1,980	1,985	1,995
Gallons consumed (millions)				
gasoline	166.81	163.53	164.65	165.48
diesel	15.50	15.19	15.30	15.37
Total	182.30	178.72	179.95	180.85
Btus consumed (billions)	23,809	23,340	23,501	23,618
Bbl consumed	4,035,424	3,955,932	3,983,220	4,003,051

1 gallon gasoline = 130,000 Btus
 1 gallon diesel fuel = 137,000 Btus
 1 barrel crude oil = 5,900,000 Btus (average)

Fuel consumption standards: Federal Highway Department
 Conversion sources: Department of Energy
 Environmental Protection Agency

Source: Bechtel/Parsons Brinckerhoff

Table 4.44

**TOTAL ANNUAL ENERGY REQUIREMENTS
(Year 2010)**

	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
Total energy used (equivalent barrels of crude oil)	4,037,449	3,968,889	3,989,641	4,007,852
Percent change in energy consumption compared to Scheme Z	N/A	-1.73	-1.20	-0.73

Source: Bechtel/Parsons Brinckerhoff

Table 4.45

**ANNUAL INDIRECT ENERGY CONSUMPTION
(Year 2010)**

	Scheme Z	Alternatives		
		8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
electrical use (BTUs) (millions)	11,946	76,451	37,885	28,328
Bbl consumed	2,025	12,958	6,421	4,801

Source: Bechtel/Parsons Brinckerhoff

4.11.1 Short-Term Uses And Long-Term Productivity

All four designs are based on State and local comprehensive planning to meet current and future traffic requirements of the Central Artery/Tunnel Project in the Area North of Causeway Street. They are designed within the context of present and future land use development in the area. Therefore, the short-term use of resources required to implement these designs is consistent with the maintenance and enhancement of the long-term productivity of the subarea.

4.11.1(a) Scheme Z

The construction duration for Scheme Z is estimated at 8.5 years. Construction of Scheme Z is planned to minimize impacts on the environment by maintaining traffic operations on existing portions of the highway. Traffic detour management will provide for uninterrupted vehicular traffic flow during construction. Scheme Z has minimal impact to navigation in Charles River.

Existing public parking spaces that are displaced due to construction are replaced at new sites. Potential neighborhood impacts are mitigated by measures identified in construction contract specifications. Noise and vibration impacts of the construction activities are reduced by requiring that construction activities and equipment meet local and Federal noise regulations.

Air quality effects during construction caused by detouring of traffic and by the construction activities are minimized by the scheduling of construction activities, by imposing maintenance programs for construction equipment, and by modifying existing traffic controls and traffic signal timing where appropriate. These measures will be specified in detail based on consultation with local and State agencies during completion of the final design of the preferred alternative.

In the long term, Scheme Z results in improvements to transportation services and potential increases in development opportunities in the Area North of Causeway Street. Scheme Z also reduces traffic levels on existing streets in central Boston, Charlestown, and Cambridge. The cumulative mass of bridge and ramp structures has a major visual impact in this area, slightly reduced by removal of the existing I-93 viaduct.

4.11.1(b) Alternative 8.1D Mod 5

The estimated construction duration for Alternative 8.1D Mod 5 is approximately 13 years. Construction of the Project is planned to minimize impacts on the environment by maintaining existing traffic operations within the Area North of Causeway Street. Also, construction within and adjacent to the Charles River uses methods, and is staged, to minimize disruption to navigation during the peak recreational boating season. Automobile traffic detour management provides for uninterrupted traffic flow during construction.

Existing public parking spaces within the area affected by the alternative are replaced at new sites. Surrounding neighborhood impacts, such as increased use of local streets by construction vehicles, are controlled by the possible use of designated haul routes.

Noise and vibration impacts of the construction activities are reduced by requiring that construction activities and equipment meet local and Federal noise regulations.

Air quality effects during construction caused by detouring of traffic and by the construction activities are minimized by imposing maintenance programs for construction vehicles and by specifying detour routes that avoid or minimize traffic delays. These measures will be specified in detail based on consultation with local agencies during completion of the final design of the preferred alternative.

Dredging operations in the Charles River for the river tunnel result in increased turbidity. This temporary impact is expected to be minimized to the extent possible by the use of a master pile/sheet pile system or silt curtains.

In the long term, Alternative 8.1D Mod 5 results in substantial improvements to transportation services and potential increases in development opportunities within the regional transportation network. Removal of the existing I-93 viaduct and reduction in the number of loop ramps in Charlestown and Cambridge, because of the three-lane tunnel in the Charles River, improves aesthetic conditions in the surrounding communities. The potential open space development benefits are relatively greater with this alternative due to the extensive use of tunnels. In addition, the extensive use of tunnels provides a long-term aesthetic benefit. These tunnels make construction more complex in this area, and its duration is the longest of any of the alternatives.

4.11.1(c) Reduced River-Tunnel Alternative

The estimated construction period for the Reduced River-Tunnel Alternative is 9 years. Construction of the alternative is planned to minimize impacts on the environment by maintaining traffic operations. Traffic detour management provides for uninterrupted vehicular traffic flow during construction. In addition, construction within and adjacent to the Charles River uses methods, and is staged, to minimize navigation disruption during the peak recreational boating season.

The short-term uses of the environment are expected to be similar but of slightly shorter duration than Alternative 8.1D Mod 5.

The Reduced River-Tunnel Alternative results in substantial improvements to transportation services and in potential increases in development opportunities within the regional transportation network. This alternative also results in long-term improvements to the aesthetic conditions in surrounding communities. The aesthetic impacts of a smaller mainline bridge are improvements over Scheme Z.

4.11.1(d) Non-River-Tunnel Alternative

The estimated construction period for the Non-River-Tunnel Alternative is 8.5 years. Construction of the alternative is planned to minimize impacts on the environment by maintaining traffic operations. Traffic detour management provides for uninterrupted vehicular traffic flow during construction.

The short-term uses of the environment are expected to be similar to Scheme Z, with minimal impact to navigation in the Charles River.

This alternative results in substantial improvements to transportation services and in potential increases in development opportunities within the regional transportation network. The cumulative long-term benefits of this alternative are beneficial to the regional environment and far outweigh the short-term adverse impacts.

4.11.2 Summary

Construction of any of the four designs includes measures to mitigate potential short- and long-term adverse impacts. With the above general commitments, the short-term construction period impacts are minimized while enhancing the long-term productivity of the environment. Moreover, the cumulative impacts of the Project outlined in Section 4.12 are considered beneficial to the regional environment, and far outweigh local adverse impacts. This conclusion is the same as for the entire Central Artery/Tunnel Project, as stated in the 1991 FSEIS/R.

4.12 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The implementation of Scheme Z or any of the three new design alternatives involves the permanent commitment of resources. This section discusses the natural, physical, and fiscal resources that are committed in the Area North of Causeway Street, and the relationship of the Project to other projects, existing or planned, in the subarea. The resources expended for the Project as a whole, and its relationship to projects in other subareas, are detailed in the 1991 FSEIS/R and are not repeated here.

4.12.1 Commitment Of Resources

The resources are being committed to the Project in the Area North of Causeway Street so that the Central Artery/Tunnel Project can be completed to improve the quality of the regional transportation system. Benefits will consist of improved accessibility, savings in travel time, and greater availability of quality services which outweigh the commitment of these resources.

Onetime Expenditure. Construction, right-of-way acquisition, and environmental mitigation for any of the four designs will require a substantial expenditure of State and Federal funds which are not retrievable. Construction of any one of the three new design alternatives to Scheme Z will add to the estimated amount. These estimated costs, in August 1993 dollars, are as follows:

Scheme Z	\$ 489 million
Alternative 8.1D Mod 5	\$1,282 million
Reduced River-Tunnel Alternative	\$1,131 million
Non-River-Tunnel Alternative	\$ 995 million

Raw Materials. Considerable amounts of labor, fossil fuels, British thermal units (Btu), and highway construction materials such as cement, aggregate, bituminous material, and steel will be expended in constructing any one of the four designs. In addition, large amounts of labor and natural resources are used in the fabrication and preparation of the designs. The total energy expenditures in the construction of the four designs are not retrievable.

Land/Building Acquisition. The permanent acquisition of land is required for the Charles River crossing. The following figures are approximate acreages:

Scheme Z	18 acres
Alternative 8.1D Mod 5	20 acres
Reduced River-Tunnel Alternative	25.5 acres
Non-River-Tunnel Alternative	29 acres

The above acreages do not include Boston and Cambridge city streets or MHD-owned property. In addition, under the new design alternatives, the Anelex building, and the Boston Thermal Energy Corporation's Minot Station are displaced. The Spaulding Rehabilitation Hospital will be taken. With all alternatives, acquisition of a portion of a private contractor's storage building is necessary; and there is some impact to two outdoor athletic facilities of Bunker Hill Community College, requiring their reconfiguration.

Air Rights. The development of air rights above the Project right-of-way is not precluded. The Non-River-Tunnel Alternative affects development of the air rights garage planned by the MBTA over the railroad tracks north of the new Boston Garden development.

Wetlands. In all designs, removal of the present I-93 piers (except the banana pier) enhances the Charles River. The three new design alternatives displace 1 acre of the Millers River. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative considerably increase the area of encroachment into the Charles as compared Scheme Z and the Non-River-Tunnel Alternative.

Parklands. The open space available for proposed parkland on both banks of the Charles River is expanded under all designs. Expansion of the south bank corridor from the Esplanade to the Harbor is made possible. There is some encroachment on the area by the structures of Scheme Z. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative require tunnel access/egress headhouses.

Shadows. Shadow impacts are greater under Scheme Z than any of the three new design alternatives, which have narrower bridges, with consistent profiles and fewer loop ramps. All of the new design alternatives create substantial shadow impacts. Shadows from existing highway structure are eliminated with Scheme Z or with any of the alternatives. The benefit to the City remains as stated in the 1991 FSEIS/R: the Project reverses the prior commitment of such resources by the existing elevated Central Artery.

4.12.2 Relationship To Other Projects

Several projects in the Area North of Causeway Street by other proponents are underway or are planned for construction concurrent with the Project. Construction must be coordinated to avoid conflicts and to avoid disruption of businesses and of vehicular and pedestrian traffic. In some cases, as with the CANA project, a tie-in with Project components is necessary. Cooperation among all agencies and private developers, and coordination of schedules and planning details will contribute to an orderly progression of all undertakings.

CANA. CANA project ramps provide connections between I-93 and Route 1.

MBTA.

Underground Parking Garage: Since the 1990 publication of the FSEIS/R, construction has been initiated on a 1,300-space underground parking garage behind the Boston Garden.

North Station Transportation Improvement Plan: Commuter railroad service is to be upgraded:

- extension of the 10 railroad tracks and high-level platforms 275 feet south toward the north facade of the existing Boston Garden
- construction of a new Green/Orange Line superstation below grade at North Station
- replacement of the Green Line now on viaduct on Causeway Street with a new below-grade alignment behind Boston Garden and through the edge of the 1,300-space garage mentioned above

Also included are the foundation supports for development of a future air rights parking garage over the railroad tracks.

Subway Stations: A new and relocated Lechmere station is planned in East Cambridge. Science Park station is affected by the Project and will be reconstructed by the MBTA in coordination with MHD.

North/South Station Rail Link: The feasibility of a rail link between North and South Stations is being studied separately by the Massachusetts EOTC and the Federal Transit Administration (FTA). Alternative alignments take the new underground Artery into consideration. The Project alignments in any design do not preclude this rail link.

Private Developments.

New Boston Garden Corporation: Since the 1991 FSEIS/R, construction has begun on a 19,500-seat sports arena in air rights above the MBTA garage. In addition, a future commercial complex will encompass the site of the existing Boston Garden and adjacent areas north of Causeway Street, and will include office and retail uses.

Massachusetts General Hospital: A garage/office building is planned to be built over a parcel of land along the east side of Nashua Street between the Spaulding Rehabilitation Hospital and North Station.

West End: The last parcel of the West End Urban Renewal Area adjacent to Charles River Park will be developed by Lowell Square Associates. The project includes cooperative apartments, elderly housing, a visitors center, underground parking, and commercial space.

North Point, East Cambridge: Multiple unit housing, a hotel, and office buildings are planned for the area bounded by the Gilmore Bridge, commuter railroad tracks, and the Charles River.

5. Construction Impacts

Chapter 5

CONSTRUCTION IMPACTS

This chapter presents a preliminary description of how the Charles River crossing will be built, for Scheme Z and the three alternatives. This discussion is based upon conceptual design a level of design customary for EISs. The chapter briefly describes the construction staging sequences, and compares the temporary construction period impacts of Scheme Z and the alternatives. In addition, temporary mitigation measures required during construction of each design are discussed.

In general, construction period impacts for any of the four designs will cause disruption in the Project area. Accordingly, construction staging plans have been designed to safely and efficiently maintain traffic and to minimize any adverse effects of construction activities to individuals, natural resources, business operations, and structures within the Project area. Nonetheless, construction on the scale of the Central Artery/Tunnel Project, particularly with the alternatives in this constrained area, involves substantial disruption, with interference to the environment, facilities, and patterns of activity for an extended period of time. All bridge construction, and to a greater extent the alternatives which include tunnels in the Charles River, require turbidity controls and temporarily interfere with navigation. All of the new design alternatives also cause increased impacts to the wetlands resources of both the Charles and Millers Rivers. A mitigation program specifically for the Charles River crossing area, based on that developed for the entire Project, helps reduce these temporary adverse effects.

5.1 CONSTRUCTION PLAN

The construction plan in the Area North of Causeway Street is described in several sections in order to enable the reader to understand the construction activities and setting, and to understand how traffic will be maintained during that period. The bridges, river tunnels, and land-based tunnels associated with the four designs are complex structures which require a substantially long time for construction. There are several methods by which these structures may be built, and these methods depend on the selection of the structure type for the Charles River bridge (e.g., cable-stayed versus other bridge types) and materials. Typically, selection of structure type and materials occur at a later stage in design development than at the DSEIS/R phase. Due to the constrained corridor and competing interests in this area, however, a great deal of coordination with regulatory agencies and the affected communities has taken place to identify potential construction conflicts affecting such areas as navigation, traffic movement, fisheries, parkland, historic resources and the visual setting. With this framework in mind, preliminary assumptions about the type of bridge structure, and construction methodology and construction of the river tunnel and land-based tunnels have been made and are described in Sections 5.1.1 through 5.1.4.

The three design alternatives and Scheme Z are designed to move traffic through a complicated interchange linking major highways including I-93, Route 1, Storrow Drive, and key arterial streets. These highways carry a substantial volume of traffic which complicates construction activities in the Area North of Causeway Street. Railroad transportation facilities, active institutional and commercial uses, and navigation in the Charles River further constrain construction in this area. Scheme Z and each of the alternatives requires some degree of underpinning of adjacent structures, modifications to existing bridge and viaduct structures, construction of temporary roadway structures, and provision of staged detours, as well as construction near active commuter railroad areas, near major underground utilities, in and near the Charles and Millers Rivers, and in areas with difficult access. The ability to maintain

traffic service during construction, the duration and location of detours, the construction impacts, and the construction difficulty vary considerably for each alternative. Section 5.1.5 discusses construction staging in order to compare the temporary impacts. A detailed discussion of constructing Scheme Z is in the 1991 FSEIS/R in Chapter 20 and the Construction appendices. For comparative purposes, Scheme Z construction durations have been updated to reflect modifications to the entire Project master schedule, changes in existing conditions, and construction assumptions consistent with the three new design alternatives. Construction durations for major interstate components of Scheme Z and the three new design alternatives are similar. Completion of Alternative 8.1D Mod 5 requires additional time due to the complexity of Storrow Drive and Leverett Circle reconfiguration, and the construction of structures required for the maintenance of traffic. These updated durations are reflected in the Project construction schedules (see Figure 5.1).

5.1.1 Charles River Bridge Construction Methods

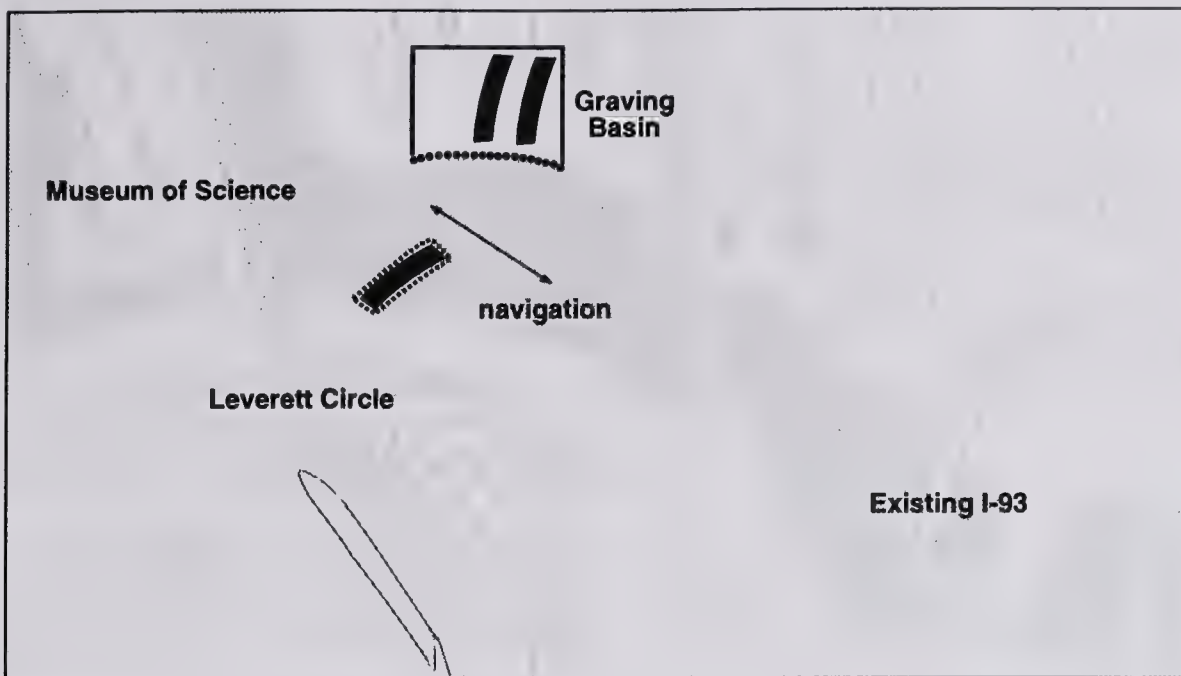
A long-span cable-stayed bridge type is proposed for Scheme Z and each of the new design alternatives (see Figures 2.24 and 2.25). Alternative 8.1D Mod 5 includes a two-span structure with a twin-legged single tower using two planes of cable stays in the back and main spans. The Reduced River-Tunnel Alternative includes a three-span structure with diamond towers using two inclined planes of stays in the main span and a single vertical plane of stays in the back spans. The proposed structure for the Non-River-Tunnel Alternative is similar; however, this alternative includes an additional crossing of the river on a continuous (no-span) box-girder bridge. These descriptions are added to assess construction impacts compared to Scheme Z.

The design of the structure, the geometrics of the crossing, and other limitations or restrictions constrain the available construction methods. In addition, maintenance of navigation in the Charles River is necessary, as is maintenance of traffic on all major interchange linkages, and these constraints are reflected in the selected construction method.

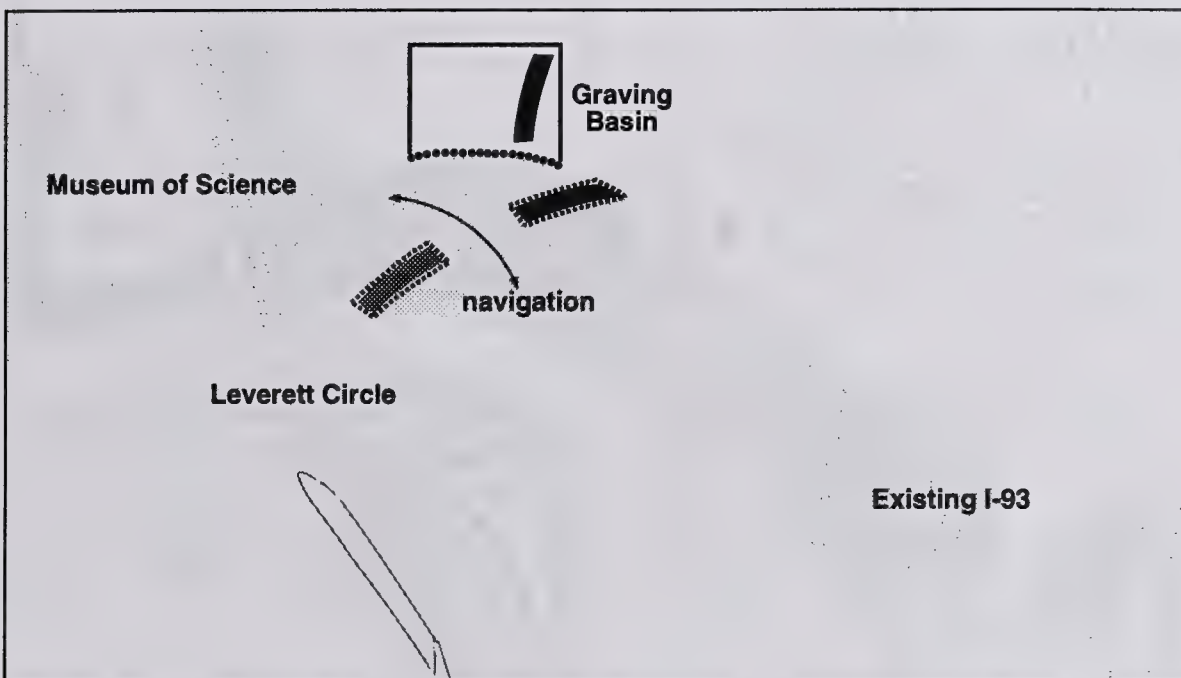
The depth of the main bridge superstructure, to accommodate an approximately 700-foot-long span, does not allow typical segmental construction. It requires the superstructure for the main span to be made of a framed system consisting of structural steel or concrete. The main span is erected incrementally, progressing from the single tower (8.1D Mod 5) or towers (Reduced River-Tunnel and Non-River-Tunnel Alternatives). As each segment of the structure is erected it initially cantilevers from the previous segment. Cable stays are installed following the erection of each segment. They are installed in the main span and back span at approximately the same time so that the load transferred to the towers is balanced by the two cantilevers. The design of the three-span structure requires that the back spans be cast-in-place on temporary structures referred to as "falsework," and anchored by additional ballast or tie-downs.

One construction method considered feasible for the spans uses stiff-leg derricks mounted on the cantilevered edge to set the structural steel framing in increments. The structural steel is lifted off barges below the structure or fed to the derricks with tower cranes erected on land alongside the piers. The derricks, structural steel, cable stays, and other material or equipment are placed on the structure using the tower cranes. The structural steel is transported to the derricks across the structure and then erected. The two-span alternative allows balanced cantilever construction from the single tower. The three-span structure requires construction of the back spans prior to the main span. The main span is constructed in operations advancing from both towers toward the center span.

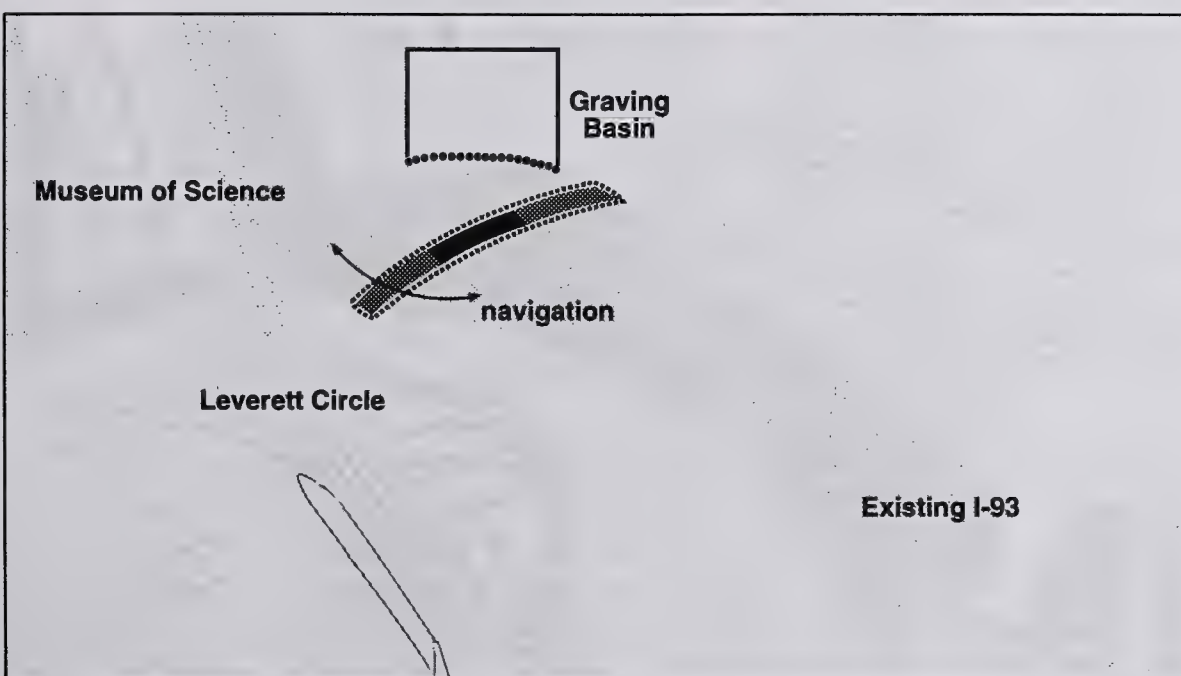
Bridge pier foundations located in the Charles River are constructed using cofferdams made of steel sheet piling. The sheet piling projects from above the high water level to below the bridge foundation or to bedrock, if the foundation bears on bedrock. The sheet piling is driven or vibrated into place using



Stage 1



Stage 2



Stage 3

impact or vibratory hammers. Cranes, either waterborne or land based, are required for this operation. The internally braced sheet pile cofferdams are excavated with a clamshell to foundation elevation. A structural concrete seal is then placed underwater in the cofferdam. Once the seal has cured adequately the cofferdam is dewatered and pier construction proceeds in the dry. After construction of the pier, the steel sheet piling is cut off at the mudline or extracted. This is typically the construction contractor's option unless conditions require the piling to remain in place to enhance the stability of the foundation.

5.1.2 Charles River Tunnel Construction Methods

The two river-tunnel alternatives include a two- to three-lane tunnel under the Charles River from a point just north of Leverett Circle on the south bank to East Cambridge on the north bank. Preliminary boring data indicate that bluish-gray moderately hard argillite is encountered approximately 70 feet below existing ground at the Leverett Circle riverbank. This bedrock has overburden measuring approximately 50 feet in depth. It is comprised of layers of fill/organic silt mix, silt, medium clay, and glaciomarine deposits. The bedrock profile rises considerably, proceeding northerly along the tunnel alignments. Approximately midriver and to the north, the bedrock is shallow and covered with overburden measuring less than 10 feet in depth.

The following methods of tunnel construction were considered prior to adopting immersed tube is the most viable potential method of construction of the river tunnel: tunneling; combined tunneling/cofferdam; staged cofferdam construction; and immersed tube. These methods are briefly described in the following subsections.

Tunneling And Combined Tunneling/Cofferdam. The tunneling and combined tunneling/cofferdam methods, which include use of tunnel boring machines, conventional mining techniques, and the New Austrian Tunneling Method (NATM), are determined to be infeasible because of the level of risk. The unacceptable level of risk is due to the variation in soundness of the underlying rock, the inadequate crown cover of rock over the relatively shallow tunnel section, and the highly variable depth to rock across the river.

Staged Cofferdam Construction. The staged cofferdam system considered consists of cellular sheetpile cofferdams constructed in two stages allowing the maintenance of navigation in half the waterway during the construction period. The work in each stage consists of cofferdam installation, dredging, blasting, rock removal, tunnel construction, backfill, and cofferdam removal. The primary concern with the staged cofferdam method is during the blasting and rock removal phase. The boring data indicate a highly variable condition of the rock in this area. Fractures, fissures, water-bearing seams, joints, intrusions, and layers of decomposition are interpreted from the available data and are anticipated from the general characteristics of the weathered argillite encountered throughout the Boston area. These conditions make cofferdam installations unstable. Cofferdam rock foundations are subject to failure under the unbalanced hydrostatic pressures. Remedial measures such as grouting, rock bolting, shoring, and bracing could be implemented, but the level of risk associated with this method is still unacceptable.

Immersed Tube. Immersed tube float-in sections are constructed of either steel or concrete. Prefabricated floating steel tube sections are precluded by the restricted width of the MDC dam locks. On-site steel fabrication entails the construction of a major facility near the Charles River Basin. The area requirements for this facility, as well as environmental, logistical, cost, and schedule considerations, make this an impractical approach. Remote fabrication of steel tube components and assembly on-site is a possible method. Concrete tubes cast in a graving basin similar to the one proposed for the Fort Point Channel crossing is considered the most likely method.

Preparation of the tunnel trench to receive the immersed tubes consists of dredging and blasting within the river area. Various tunnel activities are staged and incorporate seasonal constraints or limitations to allow for maintenance of navigation and to minimize the impacts on anadromous fish.

Tunnel Construction: A graving basin is required for casting 2 to 4 concrete tubes. An area of approximately 200 feet by 400 feet and 35 feet deep is needed for the basin. The riverside portion of the North Point area of East Cambridge is of adequate size and proximity to be used as a graving basin site. A cofferdam comprised of circular cells each approximately 35 feet in diameter is required to form a water seal access point between the graving basin and the Charles River. Following completion of the construction of the tube sections and the installation of temporary bulkheads, the cofferdam at the water access side of the graving basin is breached and the tube sections floated into position for immersion into the prepared tunnel trench (see Figures 5.1 and 5.2). The concrete tubes are partially poured so they float above the existing river bottom. This requires additional concrete pouring above the trench until negative buoyancy is achieved. This additional concreting work in situ but prior to tube placement is estimated to take 2 to 3 weeks. After the tunnel sections are placed and joined, backfilling commences using clean, washed material which minimizes turbidity.

Tunnel Trench And Turbidity Control: The tunnel trench side-slopes vary considerably depending on the composition of the river bottom. A large portion of the river bottom consists of a thin layer of material over bedrock. In these areas the stability of the trench side-slopes is of little concern. In areas where the overburden is thicker, the trench side-slopes become very flat, resulting in increased quantities of dredged material. To limit the quantity of excavated material and minimize turbidity, an underwater soil retention structure could be used. This system consists of a sheet pile/master pile system (see Figure 5.3).

The river bottom along the tunnel alignment consists of sedimentary soils deposited over bedrock. These soils, particularly the upper silt layer, produce turbidity during dredging. In addition, the silt may be contaminated. Construction of a turbidity control/excavation support structure in the bottom of the river minimizes both the volume of excavated material and turbidity.

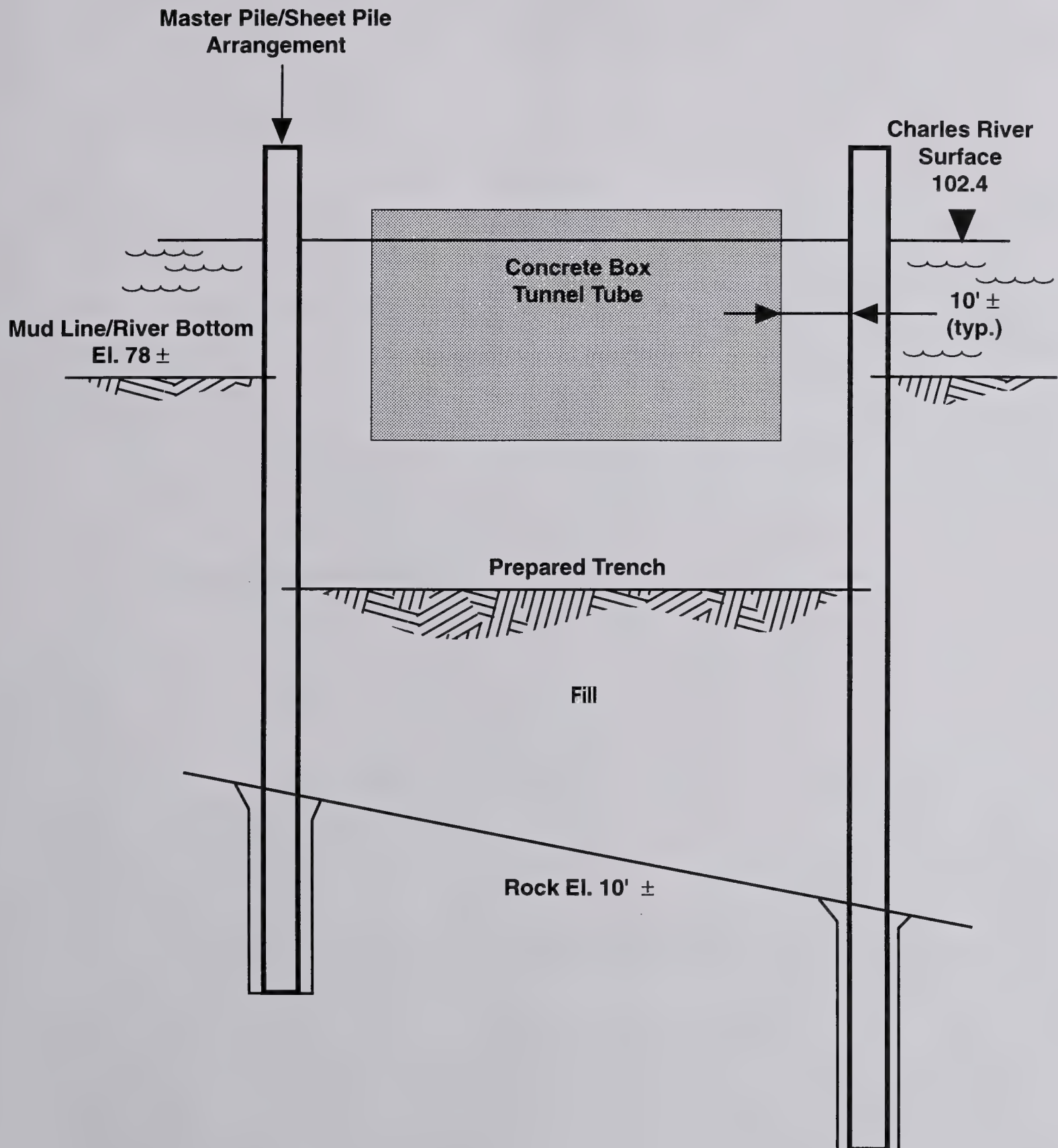
Steel pipe master piles are grouted into holes and drilled into bedrock. The master piles have interlocks welded to them to receive interlocking steel sheeting. The spaces between the master piles are filled with sheeting driven to the top of till or rock, whichever is higher. The master and sheet piles initially extend above the water surface and provide an enclosed space in which dredging, blasting, and rock excavation for the tunnel placement trench are accomplished.

The turbidity control/excavation support structure is built in stages so that it does not preclude navigation or fish migration. It temporarily constrains the function of the water basin as a holding area for boats waiting to pass the railroad bascule bridge but can be sequenced to allow vessel passage. After excavating the tunnel trench, the master and sheet piles are cut at the river bottom, leaving an underwater soil retention structure supported by the cantilever action of the master piles socketed into the bedrock. As succeeding sections of structure are constructed, the transverse walls between sections are removed at the bottom of the excavation.

5.1.3 Construction Of Land-Based Tunnels

The three new design alternatives include land-based tunnels. The construction method for the land-based tunnels is cut-and-cover. This general construction method was described in the 1991 FSEIS/R. Excavation support systems are used for all tunnel sections south of the Charles River and for a portion of those tunnel sections north of the river. The support systems are either reinforced slurry walls, steel

Tunnel Placement Cross Section



FIGURE

5.2

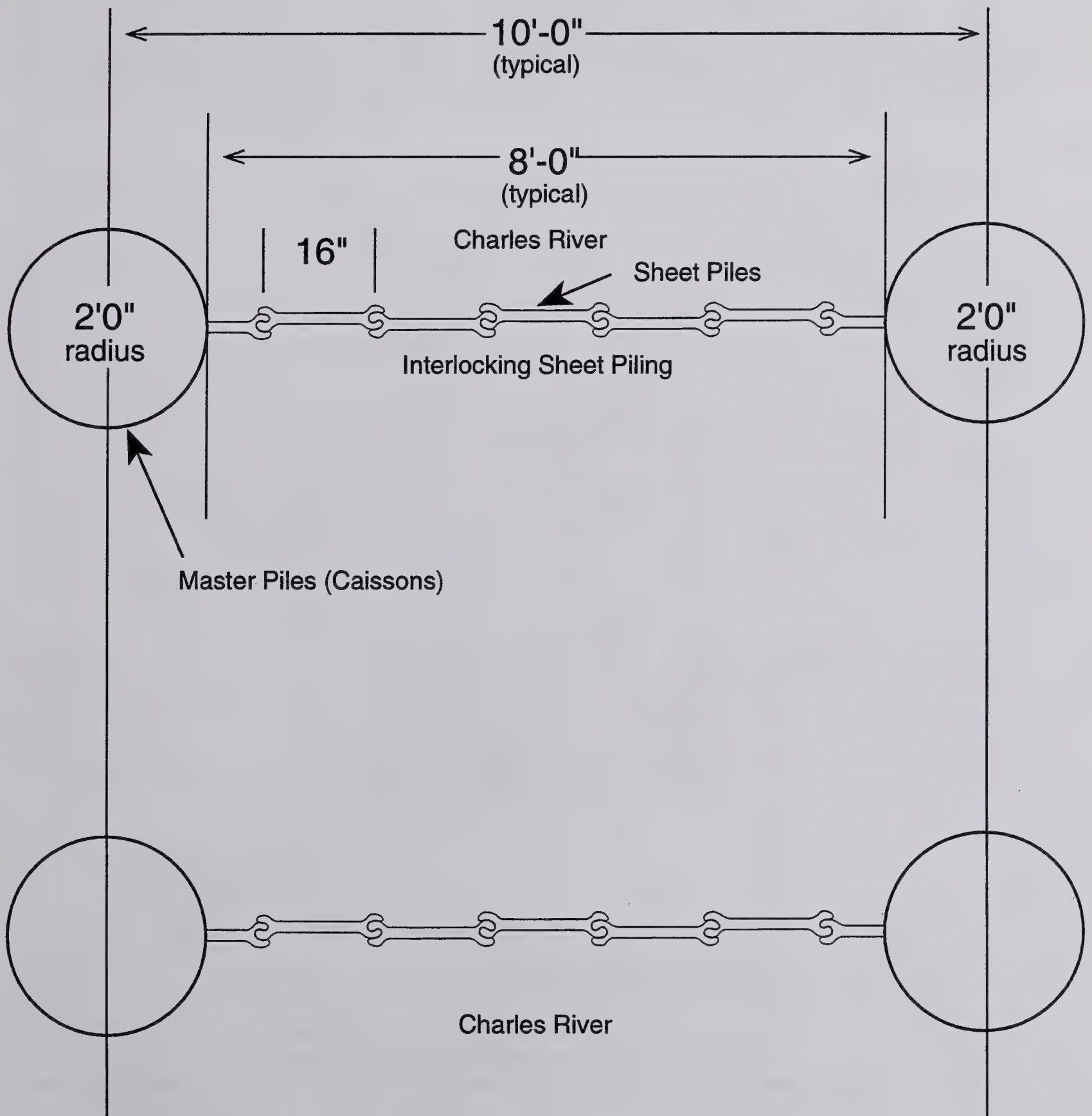
**Typical Section For Concrete
Immersed Tunnel Placement**

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
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Plan View of Master Pile/Sheet Pile Arrangement



FIGURE

5.3

Plan View Of
Master Pile/Sheet Pile Arrangement
Charles River Crossing DSEIS/R

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CENTRAL ARTERY/TUNNEL PROJECT



sheet piling, or soldier piles and lagging. Soldier piles and lagging are not used for deep excavations where groundwater is high. Alternate support systems to sheet piling are evaluated for use in areas where Project-generated vibrations must be minimized.

Tunnel construction of Ramp L-CS requires underpinning the Registry building at 100 Nashua Street. The underpinning procedure involves digging jacking pits under the pile caps of the building and jacking or installing additional supports to bearing below the tunnel subgrade. The tunnel is constructed with the supports projecting through the tunnel box. The supports are then transferred to the tunnel roof, which is designed to support these loads.

Construction Of Tunnel Sections In The Railroad Yard. All three new alternatives require construction of tunnel sections for Ramps L-CS and CN-S in the MBTA railroad yard behind North Station. The MBTA requires a minimum of eight tracks at North Station to be maintained. The six-level parking garage currently under construction behind the existing Boston Garden will accommodate the extension of 12 tracks. Presently North Station is serviced by 10 tracks with high-level platforms between the tracks. Tracks 9 and 10 will be taken out of service and sections of the tunnel ramps are constructed in the area below these tracks and to the west approximately 60 feet. Tracks 9 and 10 are then reconstructed; two additional tracks and another platform on land presently owned by the Spaulding Rehabilitation Hospital are constructed over the completed tunnel sections. Construction of the remaining tunnel sections progresses across the railroad tracks in two stages, taking four tracks out of service at a time. Construction of the tunnel is by the cut-and-cover method, by underpinning the tracks, or by a combination of the two construction methods. The MBTA has installed caissons to support future air rights development above the railroad tracks in the North Station area. Caissons in conflict with the proposed tunnels are removed and replaced outside the limits of the tunnels as the work progresses.

5.1.4 Underpinning The Existing Central Artery

Common to Scheme Z and all three new alternatives are the many columns which support the existing Central Artery mainline and connecting ramps to Storrow Drive which are in conflict with the new I-93 tunnel as it passes below. This conflict is eliminated by underpinning the existing structures, extending supports out of the limits of the travelway below. There is insufficient vertical clearance between the I-93 tunnel and the lowest northbound ramp to North Station. Prior to opening I-93 northbound, the ramp must be closed for the duration required to demolish it. Traffic will be detoured local streets during this short period.

5.1.5 Construction Staging

Conceptual construction staging plans have been developed for each of the new design alternatives (see Figure 5.4). The need to maintain traffic is a major factor in developing the construction stages and the overall durations. This section evaluates differences in construction staging among the three new alternatives. The conceptual level detours and temporary traffic moves are described for the three new alternatives. A traffic maintenance summary appears in Section 5.1.6. More detailed construction staging and traffic maintenance planning will be presented in the FSEIS/R for the preferred alternative. Complete staging and traffic maintenance plans will be developed during final design and will be coordinated with the cities of Boston and Cambridge and the regulatory agencies.

Prior to construction of any of the new alternatives, the temporary CANA loop ramps to the existing I-93 will be constructed and operational. The T-C and C-T temporary ramps provide connections between the Route 1 tunnels and the existing I-93 mainline. The existing connections to Route 1 will have been removed. Below is a summary description of traffic maintenance and construction staging in the Area

North of Causeway Street. Figure 5.6 provides a general staging diagram. Detailed staging plans will be shown for the preferred alternative in the Supportive Engineering Report in the FSEIS/R. Each stage generally represents the maintenance of traffic for that period.

5.1.5(a) Scheme Z

The construction plan and sequencing for Scheme Z in the Area North of Causeway Street are summarized here. Bridges and viaducts are the primary types of structures. Scheme Z entails construction of Charles River crossings, mainline and ramp viaduct structures, and bent modification to the existing mainline and viaduct roadways. Some tunnel transition and at-grade section construction is required. Standard techniques are used. Construction of Scheme Z requires 8.5 years to complete.

Stage 1. The MBTA Science Park station at Leverett Circle is underpinned, coordinating with the MBTA's Green Line project. Construction of the river crossing is phased so that new connections to Leverett Circle and Storrow Drive are operational before the opening of the new mainline roadways. A temporary viaduct structure is constructed across the North Station track area. Ramp viaducts completed include S-N and CN-S (partially), N-S, N-T, T-S, and S-CS. Remaining loop Ramps S-T and L-T are completed.

Stage 2. The I-93 northbound roadway is completed, including the new river crossing and viaduct structure north of the Charles, and the bent modification work required to merge the new structure into the existing roadway. The new underpass beneath Leverett Circle is completed, and the temporary viaduct structure constructed in Stage 1 is removed.

Stage 3. The I-93 southbound roadway is completed, including the new river crossing and viaduct structure, and the bent modifications required for the southbound tie-in with the existing structure.

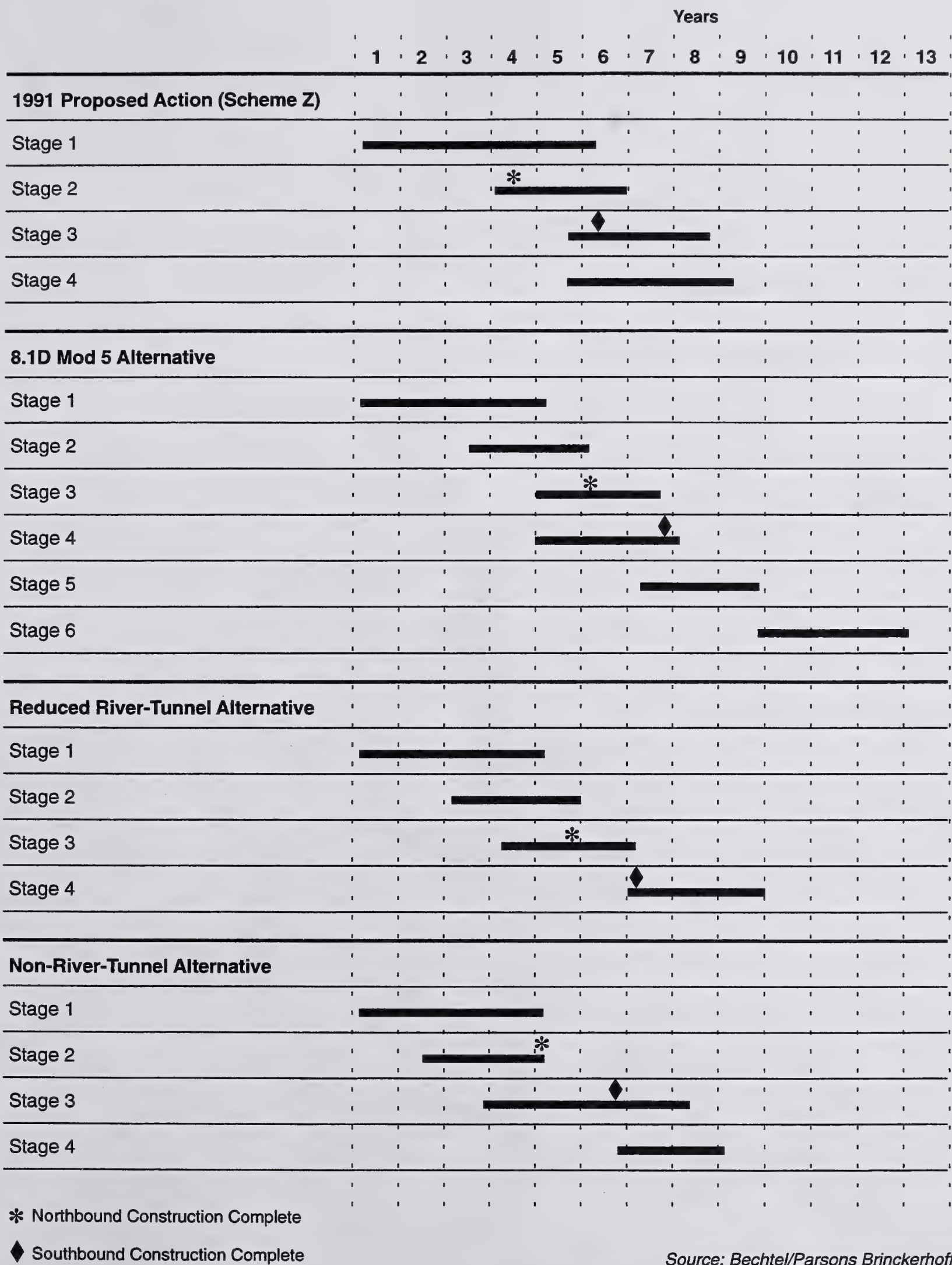
Stage 4. The existing I-93 river crossing and viaduct structure is removed, the remaining ramps are completed, and final surfacing and park restoration work are also completed. The crossing is opened to all traffic.

5.1.5(b) Alternative 8.1D Mod 5

The construction stages support in sequence an I-93 northbound opening, an I-93 southbound opening, a partial river tunnel opening, and a full river tunnel opening with approaches. An early opening of the river tunnel is infeasible because of construction and traffic complexity in the Leverett Circle area and in the MBTA Green Line corridor. Construction of this alternative requires approximately 13 years to complete. The river tunnel will not be opened to support the I-93 northbound opening. Therefore, the Storrow Drive eastbound-to-I-93 northbound, the Storrow Drive eastbound-to-Route 1 eastbound, and the I-93 northbound-to-Route 1 eastbound moves will be detoured using existing I-93 bridge structures and connections as well as new temporary structures until the river tunnel construction is completed.

Stage 1. Demolition of the Anelex building and BTEC's Minot Station steam generating plant occurs in the first few years of this stage. Major infrastructures such as the river tunnel and approaches, the mainline bridge, the tunnel portions in the railroad yard, and portions of other ramps as illustrated in Figure 5.5 are constructed in this stage. The mainline viaduct, excluding the portion in conflict with temporary ramps, is constructed to the northern limit. This is the point where the proposed and existing alignments start to converge and the structures conflict.

Stage 2. The portion of tunnel approach from the boat section of Ramp L-CS under the Leverett Circle underpass to the immersed tube tunnel transition is constructed during this stage (see Figure 5.6). A temporary detour structure is constructed between both upper and lower levels of the collector/distributor



Source: Bechtel/Parsons Brinckerhoff

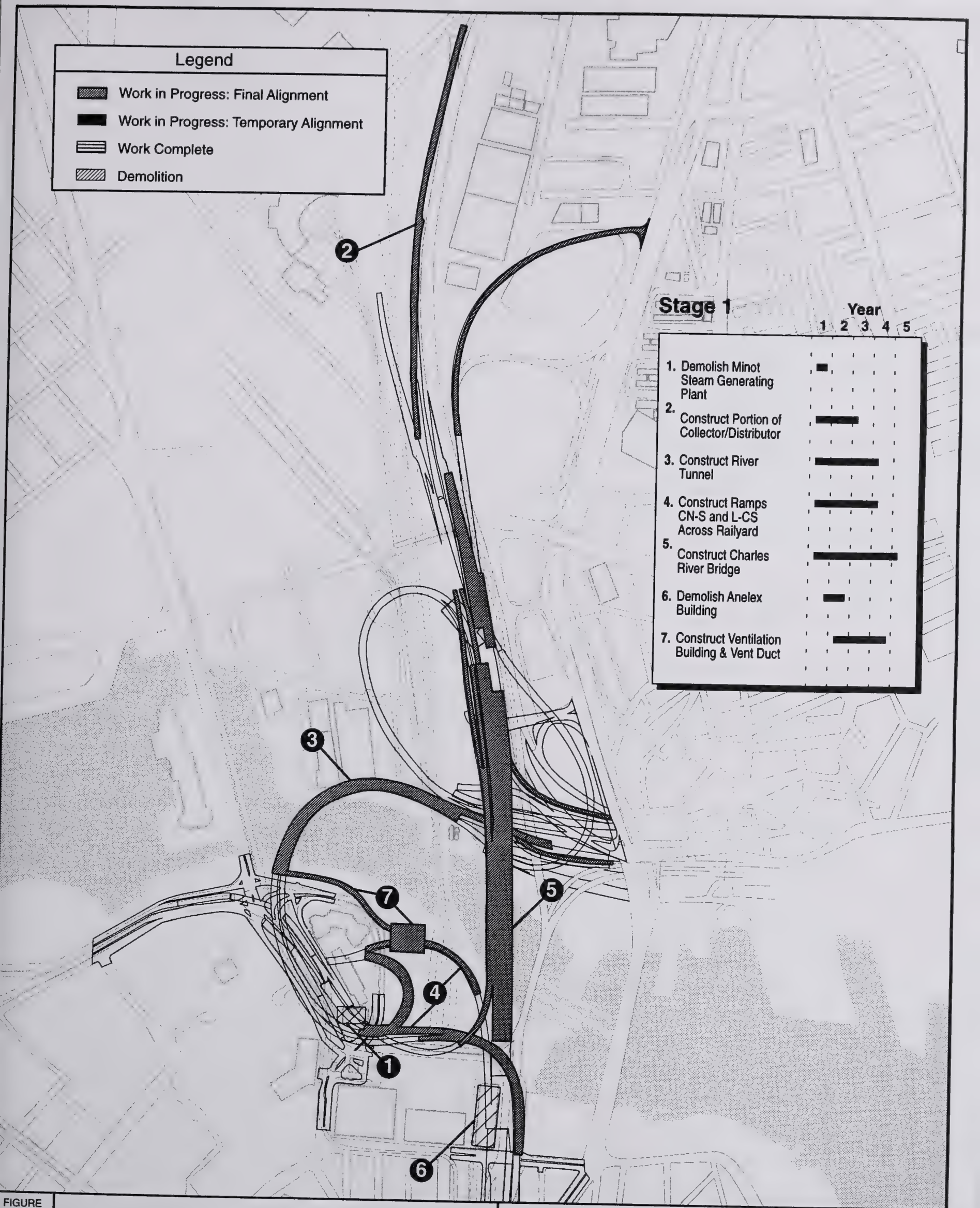
Legend

Work in Progress: Final Alignment

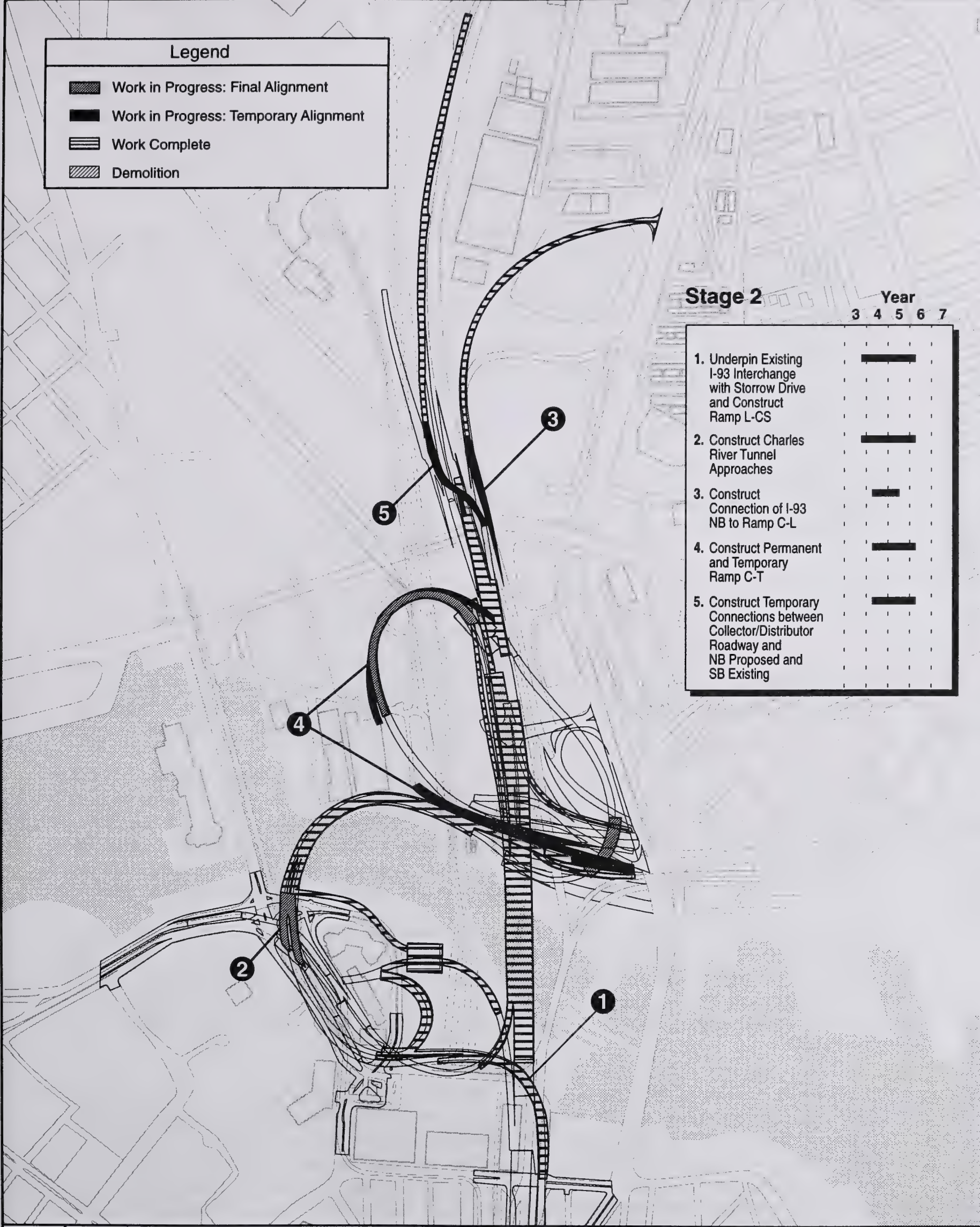
Work in Progress: Temporary Alignment

Work Complete

Demolition



Stage 1		Year				
		1	2	3	4	5
1. Demolish Minot Steam Generating Plant						
2. Construct Portion of Collector/Distributor						
3. Construct River Tunnel						
4. Construct Ramps CN-S and L-CS Across Railyard						
5. Construct Charles River Bridge						
6. Demolish Anelex Building						
7. Construct Ventilation Building & Vent Duct						



FIGURE

5.6

**Construction Stage 2:
Alternative 8.1D Mod 5**
Charles River Crossing DSEIS/R

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0 200 400 600 800 FEET



roadway and the previously constructed mainline. This permits a detour of two lanes northbound between the new northbound stub and the collector/distributor roadway crossing over the new southbound stub before connecting to the existing southbound mainline. Permanent portions of Ramp T-C are constructed and portions of a temporary ramp for two-directional use of Ramp T-C are constructed.

Stage 3. Ramp C-T is closed and traffic travelling to Route 1 northbound is diverted to Ramp C-L (see Figure 5.7). A portion of the temporary Ramp C-T is demolished. The temporary ramp is constructed and the section of the northbound mainline previously in conflict with Ramp C-T is completed. Ramp CN-S connections to Leverett Circle are completed. Additional portions of tunnel approaches are constructed. A crossover between the existing I-93 northbound and the constructed I-93 northbound is completed to allow Storrow Drive traffic travelling northbound to cross over to the constructed I-93 northbound. The existing Ramp I-93 northbound-to-North Station is demolished just prior to the northbound opening. The I-93 northbound is then opened to traffic. After the northbound opening, approximately 1,000 feet of the expressway at the northern limit are demolished and reconstructed on a new alignment. During this period, the two-directional detour constructed in Stage 2 is used.

Stage 4. The remaining portions of Ramp T-C are constructed (see Figure 5.8). Ramp N-S is constructed on a temporary alignment adjacent to existing Storrow Drive connectors. A temporary structure connecting Storrow Drive eastbound traffic to the upper level of the Storrow Drive ramps is constructed. The I-93 southbound mainline is opened to traffic.

Stage 5. Ramps L-N, L-CS, S-N, N-S, and N-T are opened to traffic (see Figure 5.9). The river tunnel is partially opened to Storrow Drive traffic.

Stage 6. The double-deck Storrow Drive connecting ramps, the Charles River bridge, and the existing I-93 are demolished (see Figure 5.10). Ramps C-T and M-N are opened to traffic. Ramp N-S is completed on final alignment and the temporary structure is removed. The river tunnel is opened to all traffic and the temporary Ramp C-T is demolished.

5.1.5(c) Reduced River-Tunnel Alternative

The construction stages are developed to support a river tunnel opening, followed by an I-93 northbound opening, and an I-93 southbound opening. The river tunnel opening is accomplished using a connection to the Route 1 tunnels and I-93 northbound on a temporary alignment north of the C-T Ramp connecting to the mainline. The early tunnel opening relieves traffic demands on connections to Leverett Circle, facilitating construction work in this area. This alternative requires approximately 9 years to construct.

Stage 1. Demolition of BTEC's Minot Station steam generating plant and the Anelex building occurs in this stage. The river tunnel and approaches, the mainline bridge, the tunnel portions in the railroad yard, and portions of other ramps as shown in Figure 5.11 are constructed in this stage. The mainline viaduct, excluding the portion in conflict with temporary ramps, is constructed to the northern limit shown. This is the point where the proposed and existing alignments start to converge and the structures conflict.

Stage 2. The river tunnel is opened at the start of this stage, reducing demands on the Leverett Circle connections and greatly reducing traffic volume on the temporary C-T ramp (see Figure 5.12). I-93 northbound-to-Route 1 northbound uses Ramp C-L temporarily connected to the existing structure. This allows completion of the mainline previously in conflict with Ramp C-T and completion of Ramp C-T in the final alignment. A temporary detour structure will be constructed between both upper and lower levels of the collector/distributor roadway and the previously constructed mainline. This permits a detour of two lanes northbound between the collector/distributor structure and the new northbound stub, and two

lanes southbound between the collector/distributor structure crossing over the new southbound stub before connecting to the existing southbound mainline. The I-93 northbound tunnel/connection to Leverett Circle is completed. The existing I-93 northbound off-ramp to Leverett Circle is demolished over the new mainline just prior to the northbound opening.

Stage 3. The I-93 northbound mainline is opened to traffic (see Figure 5.13). The existing portion of the mainline at the northern limit is demolished and reconstructed on a new alignment. Temporary connection to Ramp C-T is constructed and the ramp is operated in both directions. This allows completion of the southbound mainline. Ramp N-S is constructed on a temporary alignment.

Stage 4. I-93 southbound is opened to traffic (see Figure 5.14). The existing structures as shown in Figure 5.10 are demolished. Remaining portions previously in conflict are constructed.

5.1.5(d) Non-River-Tunnel Alternative

The construction stages are developed to support traffic to and from Storrow Drive and to complete I-93 northbound first. I-93 southbound is completed next. This alternative requires approximately 8.5 years to construct.

Stage 1. The Minot Station steam generating plant and the Anelex building are demolished; Merrimac Street and Storrow Drive are widened to accommodate traffic at the Leverett Circle underpass in the first few years of this stage (see Figure 5.15). The mainline bridge, Ramps N-S and S-N on the parallel river crossing, the Leverett Circle eastbound underpass, the tunnel portions in the railroad yard, and portions of ramps as shown in Figure 5.11 are constructed in this stage. The mainline viaduct is constructed to the northern limit shown. Temporary connection is constructed between the collector/distributor roadway and roadways shown. Ramp C-L is connected on a temporary alignment to the existing northbound expressway.

Stage 2. The I-93 southbound move on Ramp N-S to Storrow Drive is opened (see Figure 5.16). Traffic is closed on the temporary Ramp C-T and diverted to Ramp C-L. The portion of I-93 northbound previously in conflict with the temporary ramp and Ramp C-T on final alignment is constructed. The existing I-93 interchange with Storrow Drive is underpinned. The local connection to Nashua Street and the remainder of Ramp CN-S are constructed. The existing I-93 northbound off-ramp to Leverett Circle is demolished over the new mainline just prior to the northbound opening.

Stage 3. The existing portion of the mainline at the northern limit is demolished and reconstructed on the final alignment (see Figure 5.17). Temporary connections to Ramp C-T are constructed and the ramp is operated in both directions. This allows completion of the southbound mainline. Southbound connections to Leverett Circle are completed. The I-93 southbound mainline is opened to traffic.

Stage 4. The existing structures, as shown in Figure 5.18, are demolished. Remaining portions previously in conflict are constructed.

5.1.6 Maintenance of Traffic Summary

The construction staging plans described in Section 5.1.5 for all designs in the Area North of Causeway Street are intended to minimize interference with traffic operations on the existing roadway network. While most of the facilities can be constructed with no impact on the existing roadway network, there are four locations where construction staging is critical: the Leverett Circle/Nashua Street corridor, the existing-to-proposed I-93 transition, the U.S. Route 1 to I-93 southbound connection, and the MBTA Green Line reconstruction.

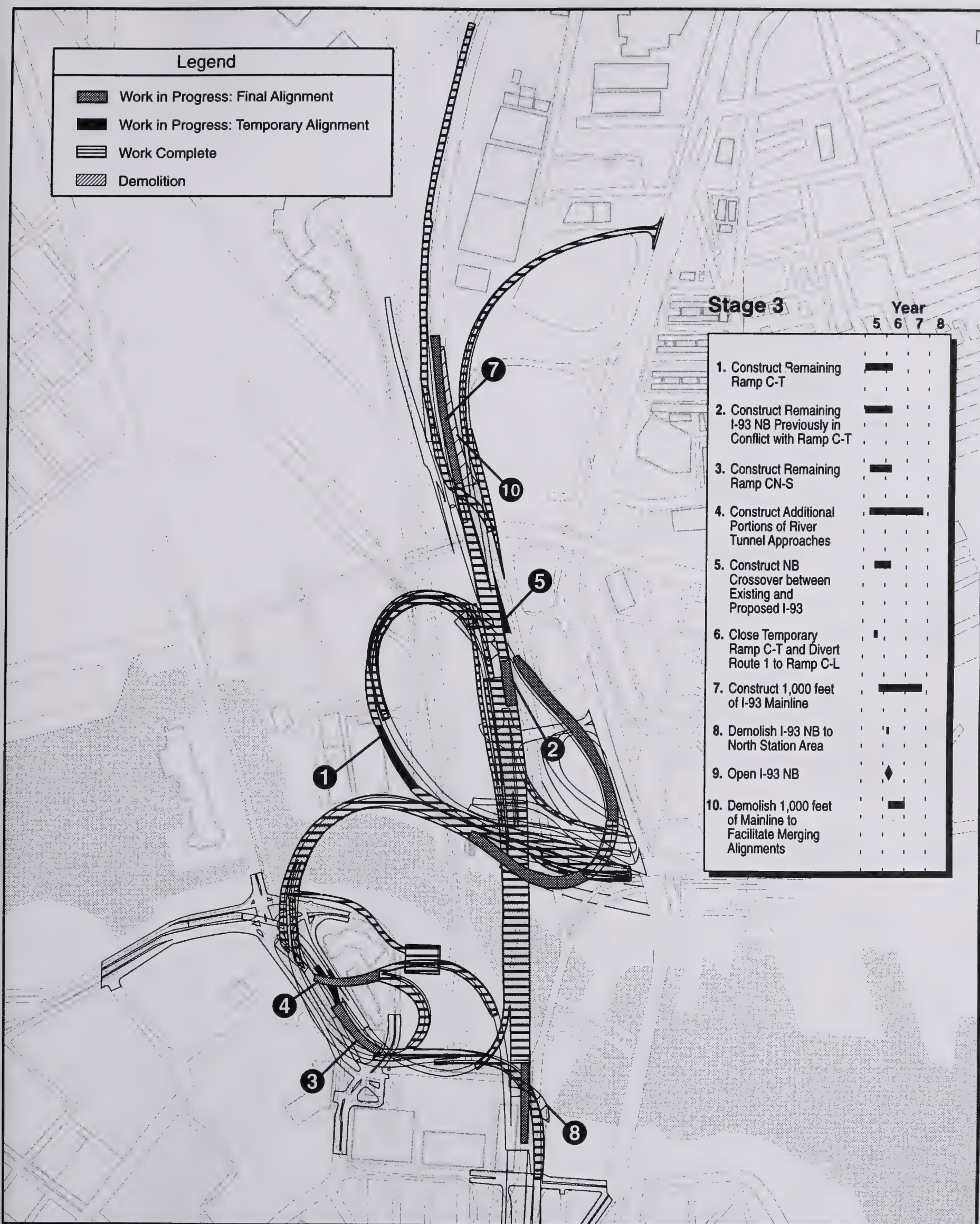
Legend

-  Work in Progress: Final Alignment
-  Work in Progress: Temporary Alignment
-  Work Complete
-  Demolition

Stage 3

Year
5 6 7 8

1. Construct Remaining Ramp C-T 
2. Construct Remaining I-93 NB Previously in Conflict with Ramp C-T 
3. Construct Remaining Ramp CN-S 
4. Construct Additional Portions of River Tunnel Approaches 
5. Construct NB Crossover between Existing and Proposed I-93 
6. Close Temporary Ramp C-T and Divert Route 1 to Ramp C-L 
7. Construct 1,000 feet of I-93 Mainline 
8. Demolish I-93 NB to North Station Area 
9. Open I-93 NB 
10. Demolish 1,000 feet of Mainline to Facilitate Merging Alignments 



FIGURE

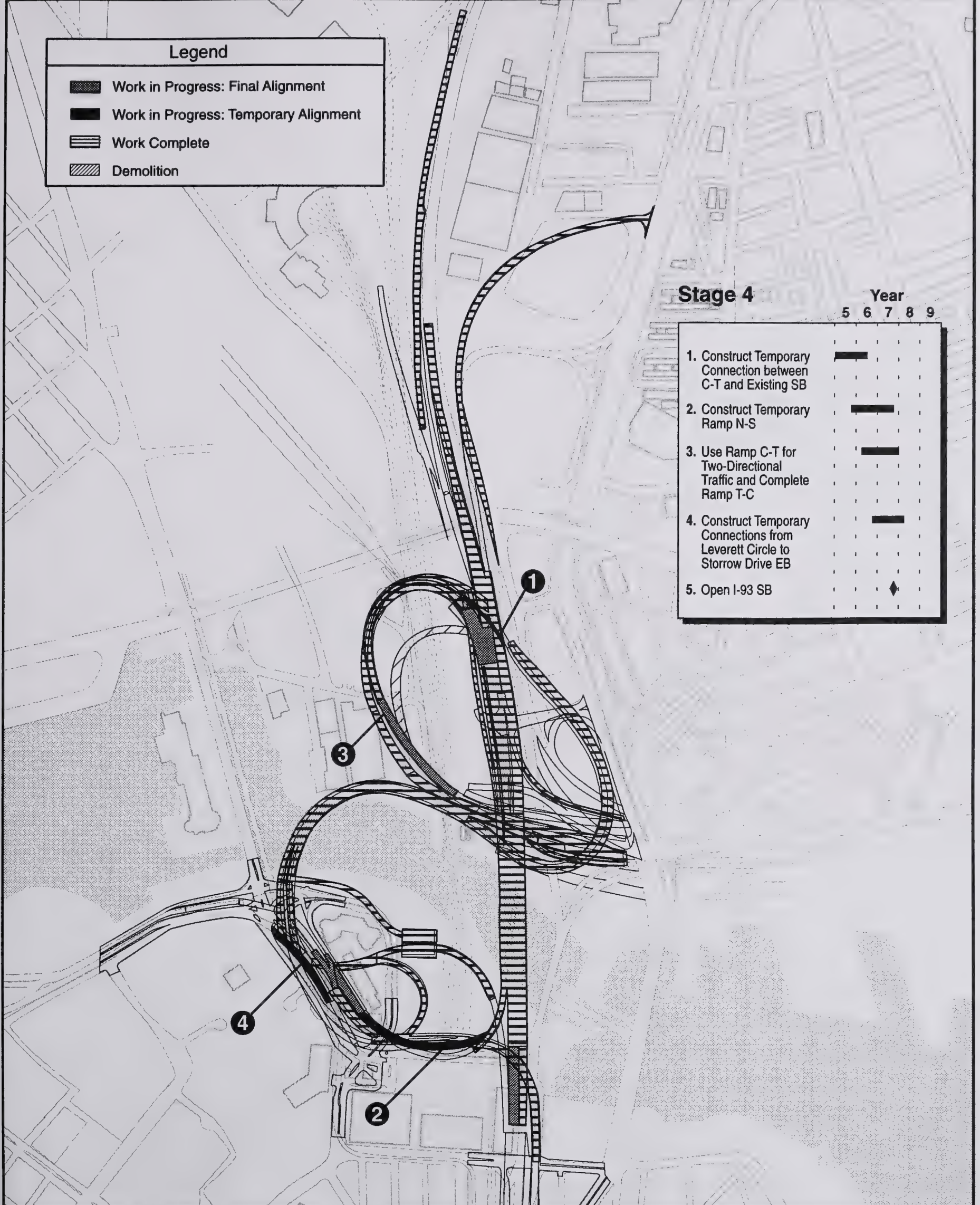
5.7

Construction Stage 3:
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 FEET





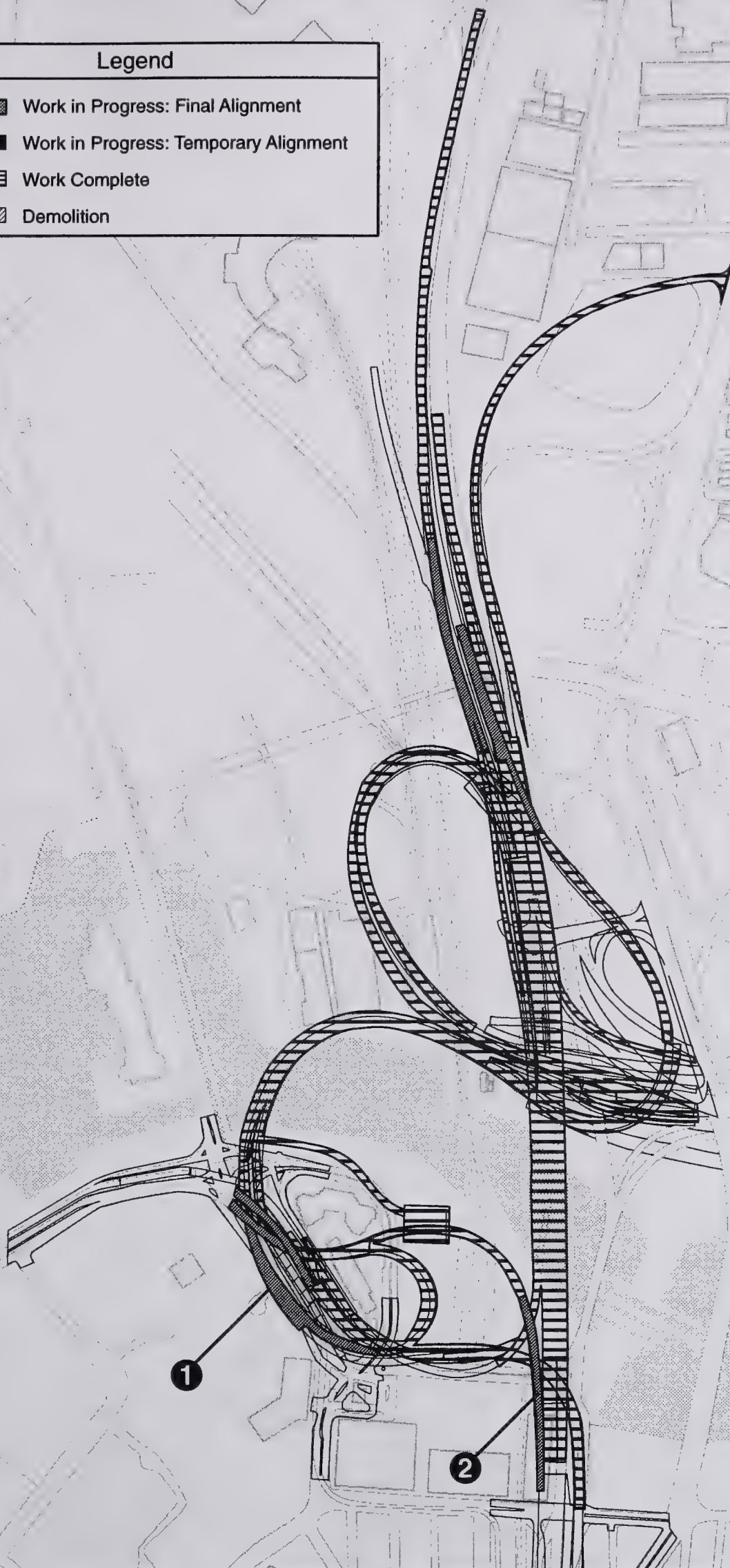
Legend

-  Work in Progress: Final Alignment
-  Work in Progress: Temporary Alignment
-  Work Complete
-  Demolition

Stage 5

Year
7 8 9 10

1. Construct Additional Portions of River Tunnel Approaches
2. Construct Remaining Ramp L-CS
3. Open River Tunnel



FIGURE

5.9

Construction Stage 5:
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R

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CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 FEET



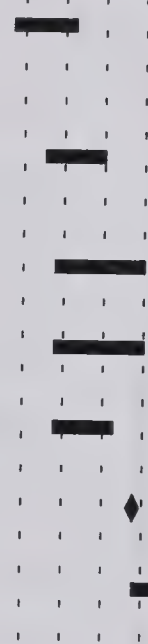
Legend

-  Work in Progress: Final Alignment
-  Work in Progress: Temporary Alignment
-  Work Complete
-  Demolition

Stage 6

Year
9 10 11 12 13

1. Demolish Existing Double-Deck Storrow Drive Connection and I-93 Mainline
2. Construct Remaining Ramp C-L and Open to Traffic
3. Construct Remaining Ramp M-N
4. Construct Remaining Ramp C-T
5. Construct Remaining Ramp N-S
6. Open Charles River Tunnel
7. Demolish Temporary Ramp C-T



FIGURE

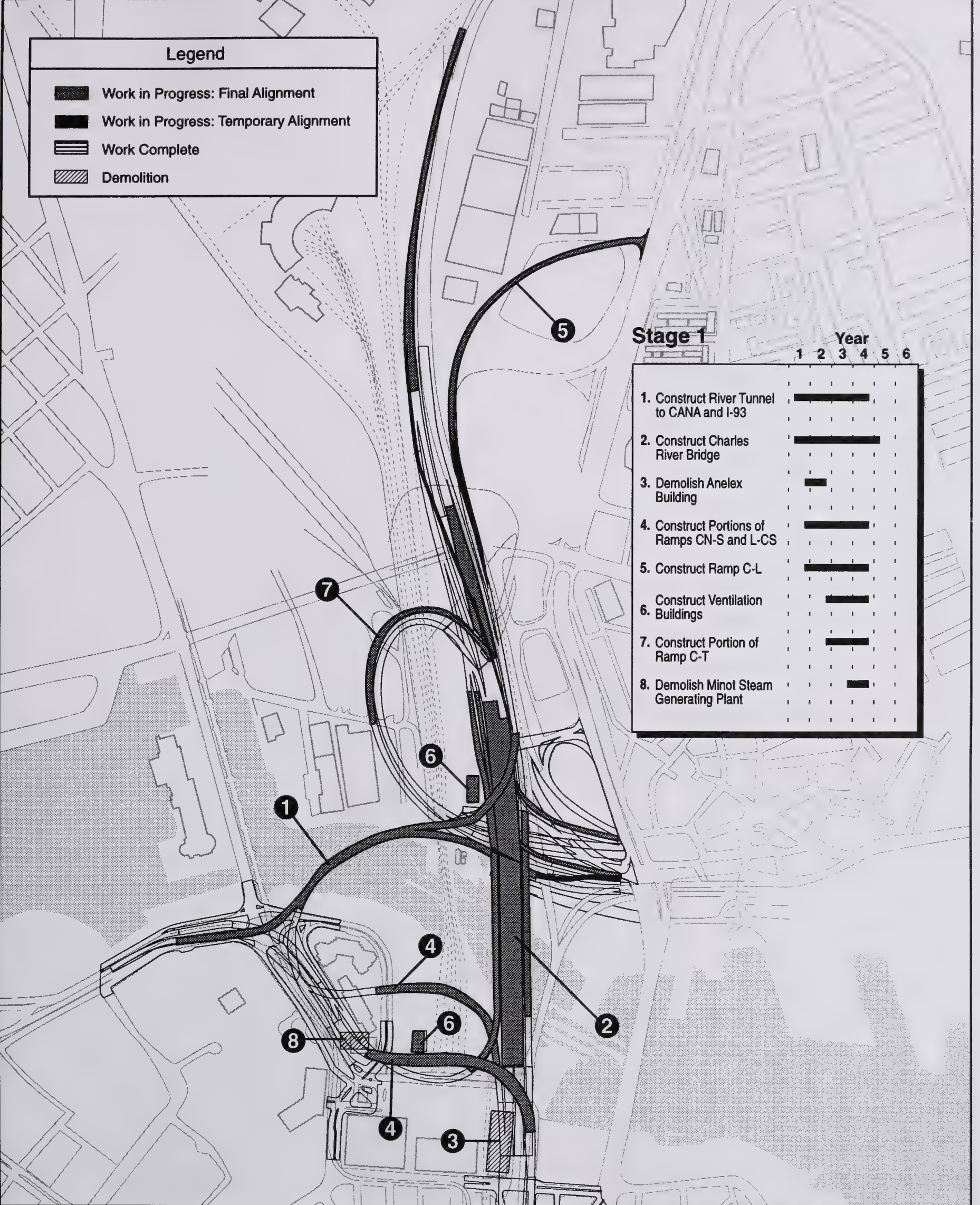
5.10

Construction Stage 6:
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R

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CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 FEET





FIGURE

5.11

Construction Stage 1:

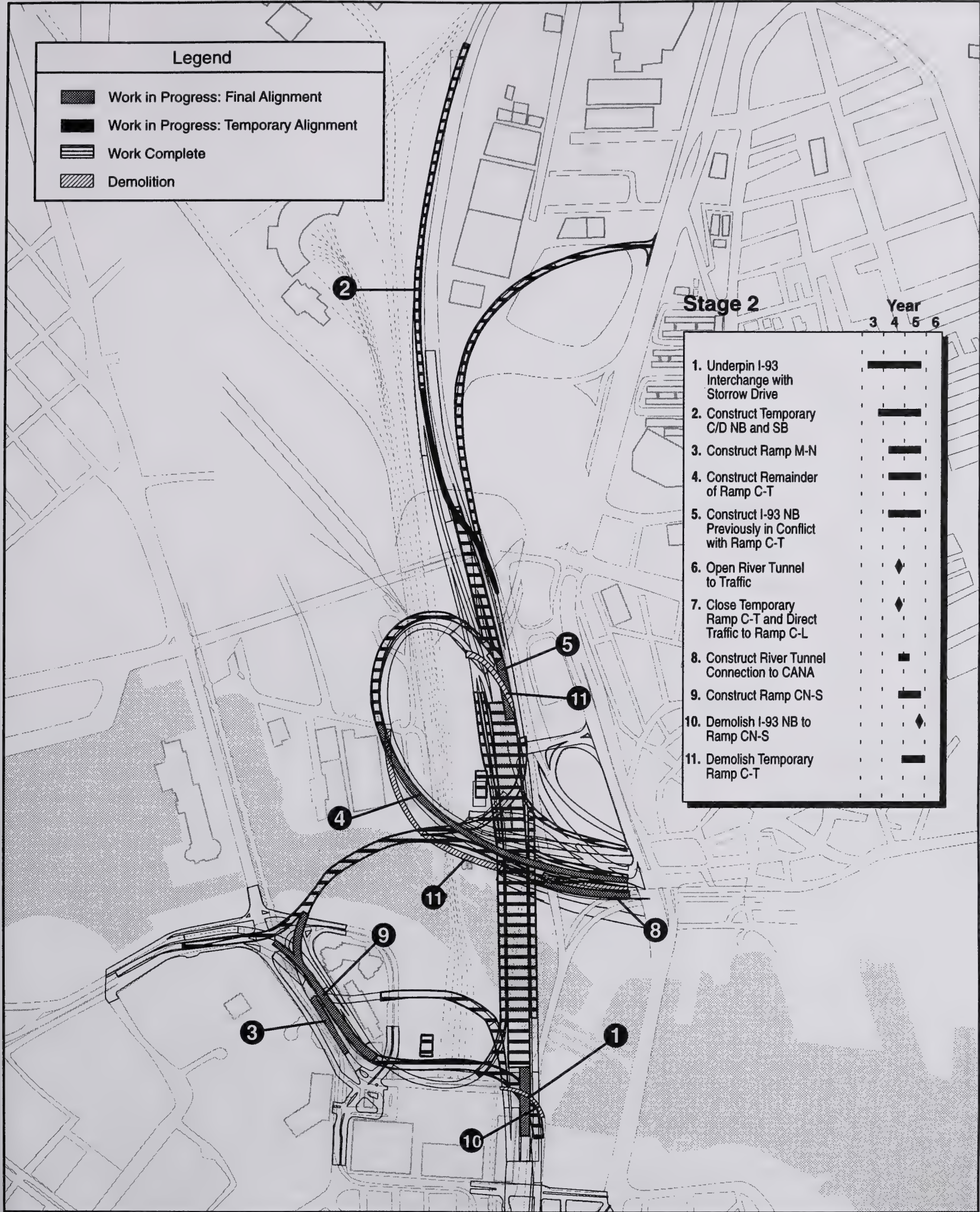
Reduced River-Tunnel Alternative

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT

CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 FEET



FIGURE

5.12

Construction Stage 2: Reduced River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 FEET



Legend

-  Work in Progress: Final Alignment
-  Work in Progress: Temporary Alignment
-  Work Complete
-  Demolition

Stage 3

Year
4 5 6 7 8

1. Construct Temporary Connections to Ramp C-T
2. Construct Ramp L-CS
3. Construct Temporary Ramp N-S
4. Construct 1000 Feet of I-93 Mainline
5. Open I-93 NB
6. Operate Ramps C-T in Both Directions
7. Demolish Temporary Ramp T-C
8. Demolish 1000 feet of I-93 Mainline to Facilitate Merging Alignments
9. Construct Remaining I-93 SB Previously in Conflict with Ramp T-C



FIGURE

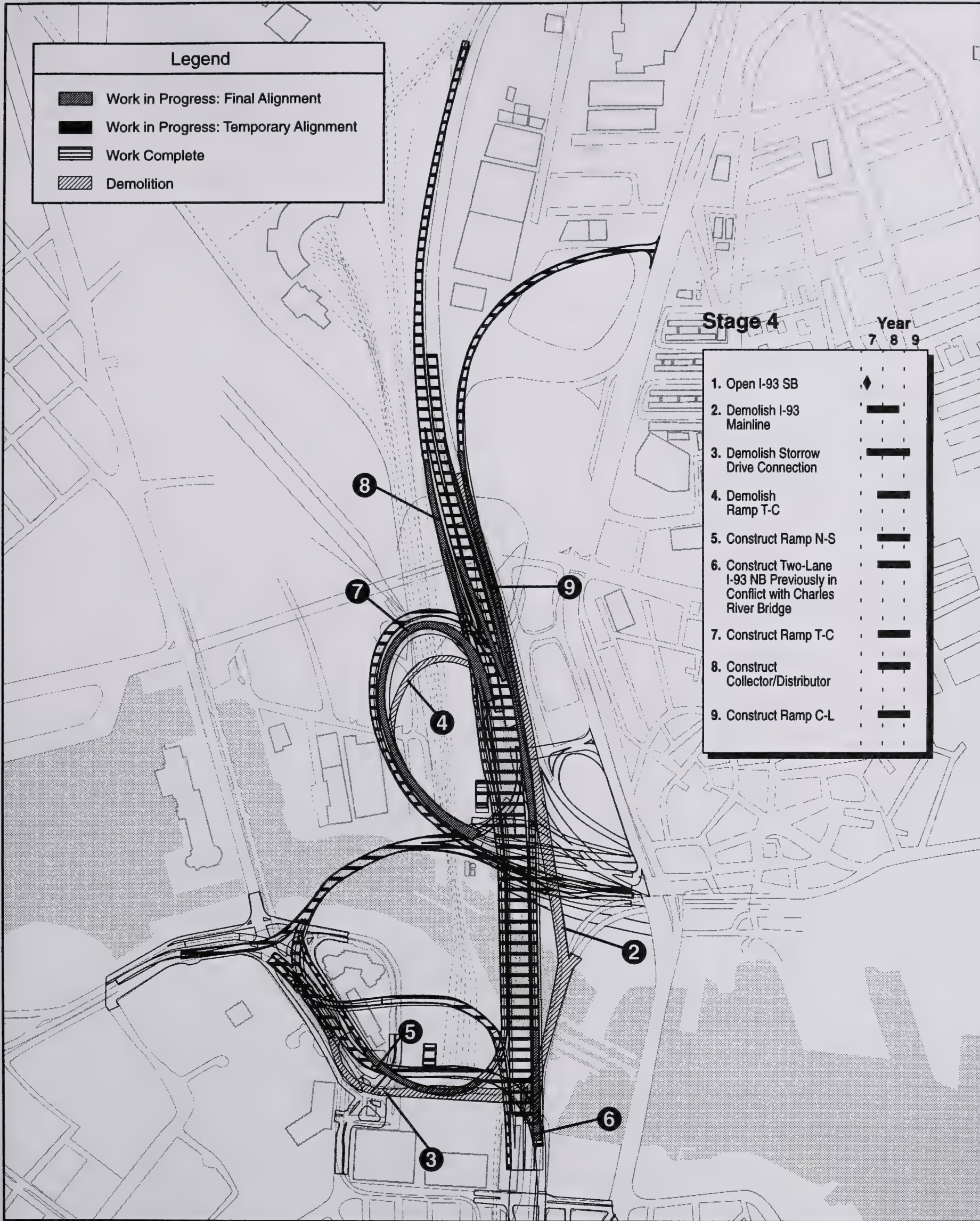
5.13

Construction Stage 3:
Reduced River-Tunnel Alternative
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 FEET





Legend

- Work in Progress: Final Alignment
- Work in Progress: Temporary Alignment
- Work Complete
- Demolition

Stage 4

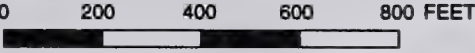
	Year
	7 8 9
1. Open I-93 SB	◆
2. Demolish I-93 Mainline	■
3. Demolish Storrow Drive Connection	■
4. Demolish Ramp T-C	■
5. Construct Ramp N-S	■
6. Construct Two-Lane I-93 NB Previously in Conflict with Charles River Bridge	■
7. Construct Ramp T-C	■
8. Construct Collector/Distributor	■
9. Construct Ramp C-L	■

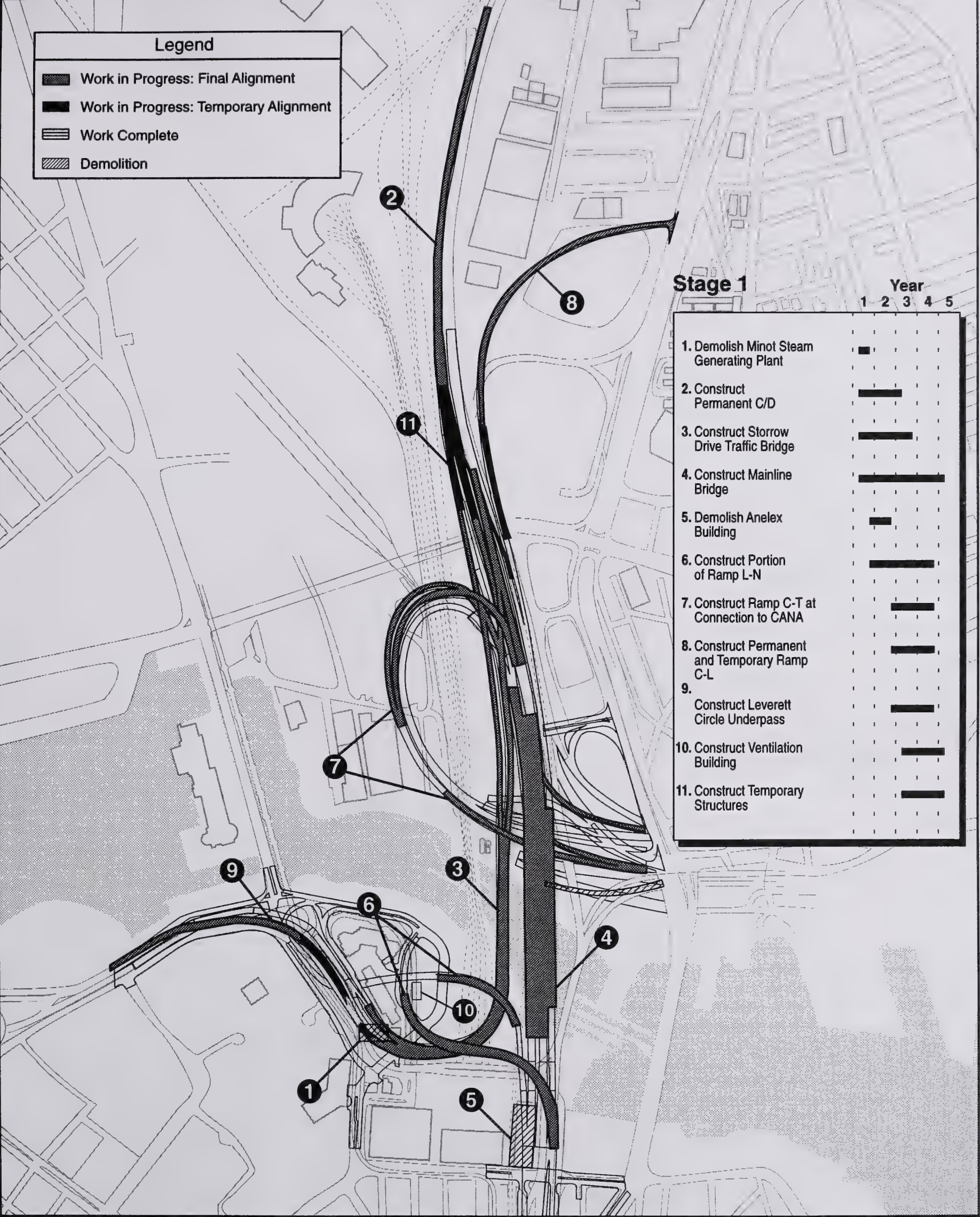
FIGURE

5.14

Construction Stage 4:
Reduced River-Tunnel Alternative
 Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
 CENTRAL ARTERY/TUNNEL PROJECT



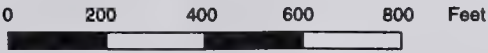


FIGURE

5.15

Construction Stage 1: Non-River-Tunnel Alternative Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



Legend

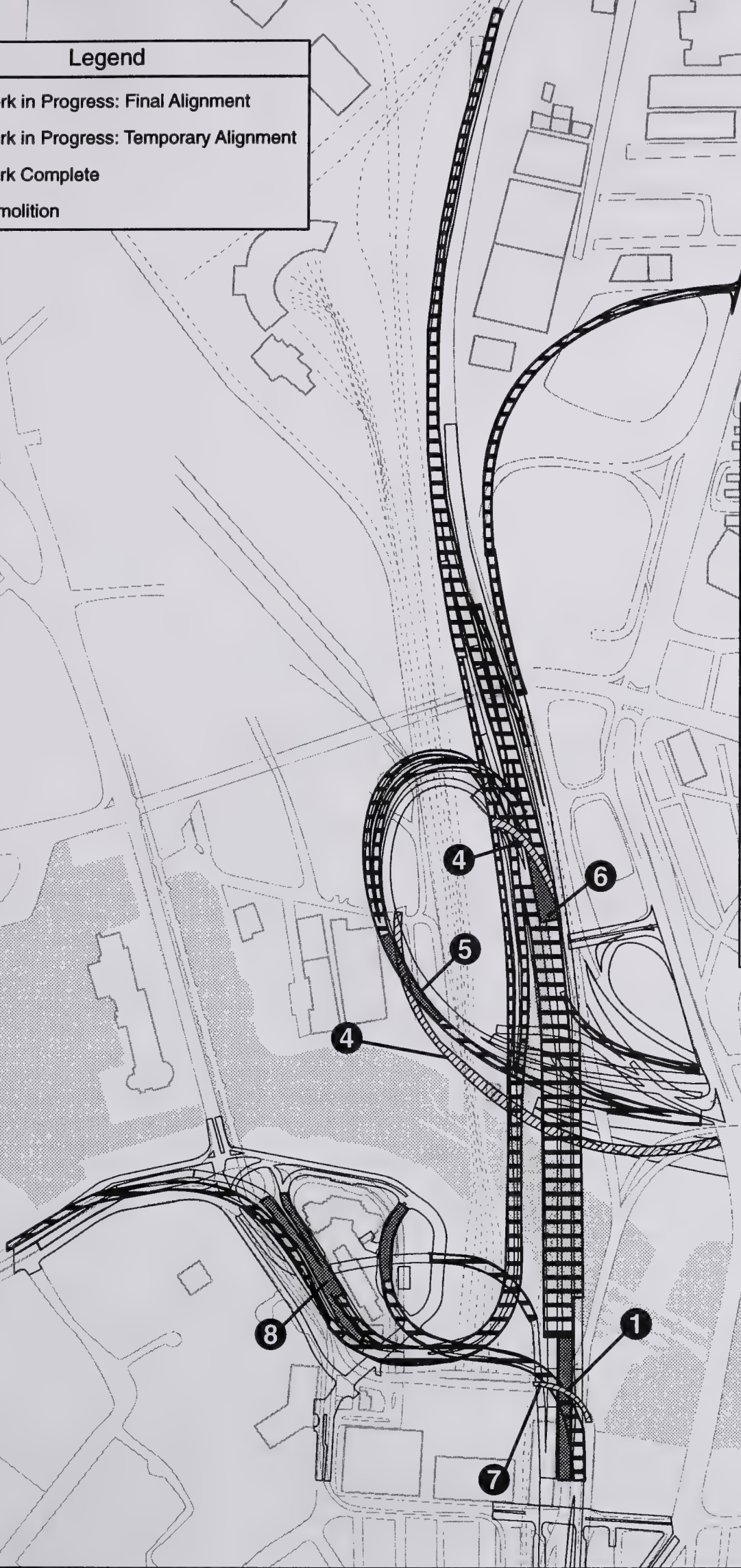
-  Work in Progress: Final Alignment
-  Work in Progress: Temporary Alignment
-  Work Complete
-  Demolition

Stage 2

Year

2 3 4 5

1. Underpin Existing I-93 Interchange with Storow Drive
2. Open I-93 SB to Storow Drive
3. Open Ramp C-L
4. Demolish Temporary Ramp C-T
5. Construct Remaining Ramp C-T
6. Construct Remaining I-93 NB Previously in Conflict with Temporary Ramp C-T
7. Demolish I-93 NB Ramp to North Station
8. Complete Ramp CN-S
9. Open I-93 NB to Storow Drive



FIGURE

5.16

Construction Stage 2: Non-River-Tunnel Alternative

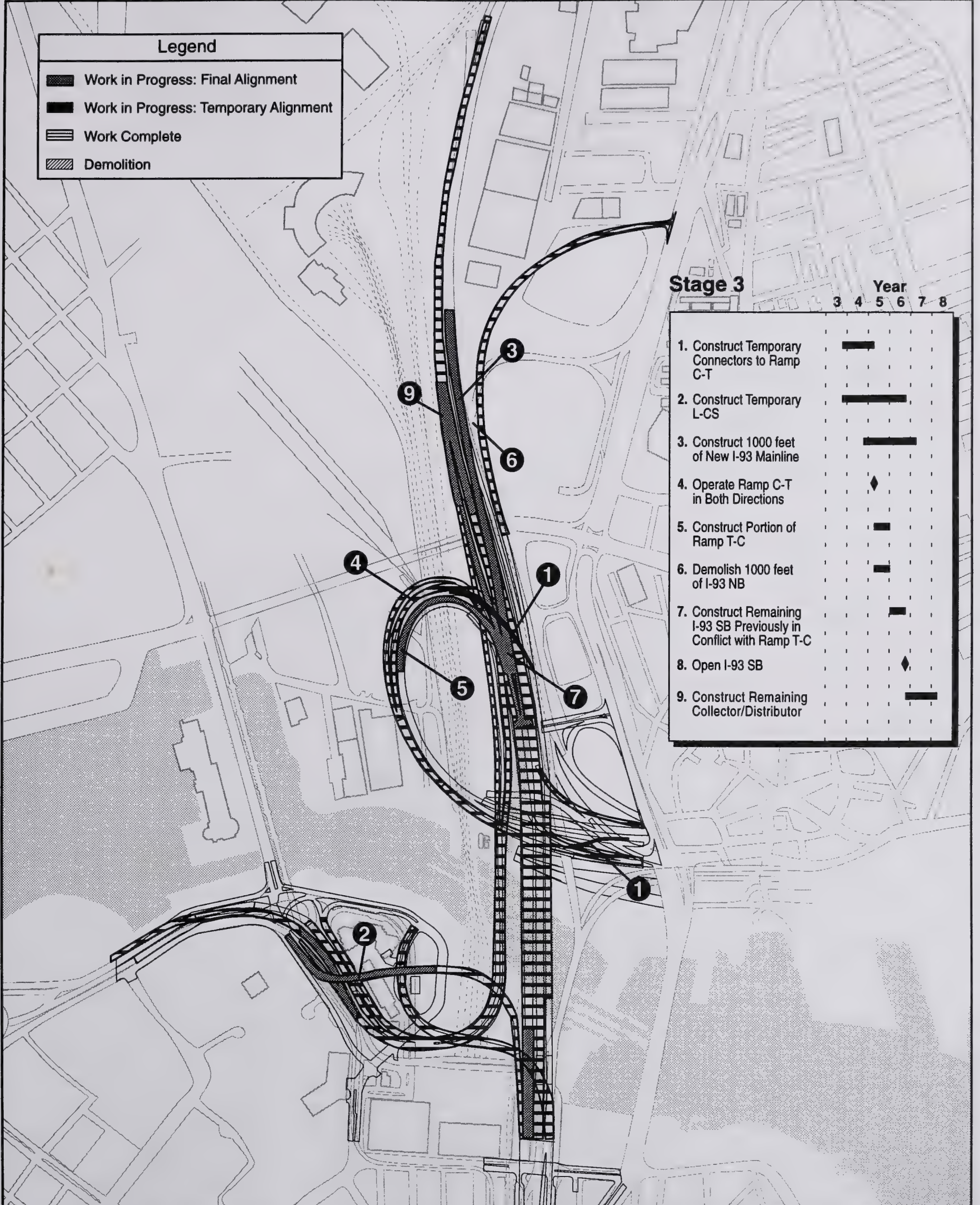
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 Feet







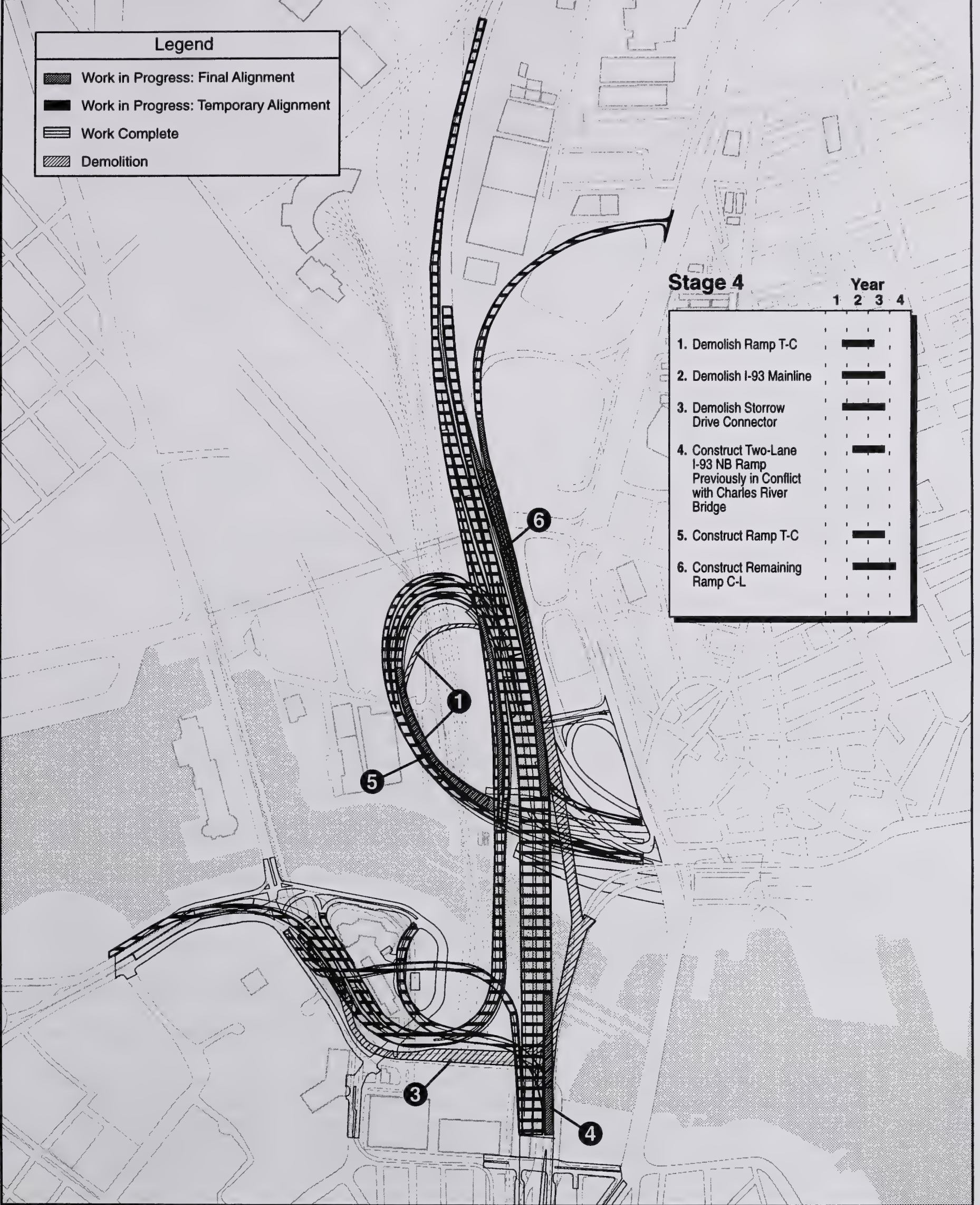
Legend

- Work in Progress: Final Alignment
- Work in Progress: Temporary Alignment
- Work Complete
- Demolition

Stage 3

	Year	3	4	5	6	7	8
1. Construct Temporary Connectors to Ramp C-T							
2. Construct Temporary L-CS							
3. Construct 1000 feet of New I-93 Mainline							
4. Operate Ramp C-T in Both Directions							
5. Construct Portion of Ramp T-C							
6. Demolish 1000 feet of I-93 NB							
7. Construct Remaining I-93 SB Previously in Conflict with Ramp T-C							
8. Open I-93 SB							
9. Construct Remaining Collector/Distributor							





Legend

Work in Progress: Final Alignment

Work in Progress: Temporary Alignment

Stage 4

Year

1

2

3

4

1. Demolish Ramp T-C

2. Demolish I-93 Mainline

3. Demolish Storow Drive Connector

4. Construct Two-Lane I-93 NB Ramp Previously in Conflict with Charles River Bridge

5. Construct Ramp T-C

6. Construct Remaining Ramp C-L

In order to widen the Leverett Circle/Nashua Street corridor, improvements to Leverett Circle, Nashua Street, Martha Road, and Lomasney Way must be made prior to construction of the ramp termini to provide an adequate number of travel lanes through all construction stages. Leverett Circle will undergo several configuration transitions during construction in order to maintain both vehicular and pedestrian movements. Alternative 8.1D Mod 5 requires the greatest number reconfiguration sequences in this area.

The transition from existing to proposed highway sections will be accomplished by temporary connections between construction stages. Most of the temporary connections are within the highway right-of-way and will not affect the surrounding roadway network. One temporary connection under the three new design alternatives, however, will use Ramps C-L and L-T and Rutherford Avenue to provide the I-93 northbound-to-Route 1 northbound movement. The movement on Rutherford Avenue is a direct ramp-to-ramp connection using the underpass at the Gilmore Bridge.

The relocation of the MBTA Green Line between North Station and Science Park station will have to be coordinated with the construction of the proposed highway ramps. The MBTA has estimated a service outage between the two stations for 18 months for demolition of the existing viaduct and construction of the new connection between the relocated line and Science Park station. This estimate was based on the concurrent construction of Scheme Z, which does not affect Leverett Circle or Science Park station. The new design alternatives, however, include a reconfiguration of Leverett Circle, which requires the reconstruction of Science Park station. Coordination with MBTA is ongoing; alternate services will be maintained during construction.

5.1.7 Commuter Railroad Impact

The proposed loop ramps from I-93 southbound to U.S. Route 1 will cross over MBTA commuter railroad tracks on the approach to North Station on the north bank of the river. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative cross under the same tracks just north of railroad Tower A. Since these are the lead tracks into North Station it is impractical to remove any of the tracks from service, with the possible exception of the easternmost lead track, without having an adverse impact on the commuter railroad operation. The construction techniques used to cross the tracks will not disrupt the commuter rail operation (see Section 5.1.3 for discussion of North Station impacts).

5.2 HAZARDOUS CARGO ROUTES

Since the existing primary hazardous cargo routes travel through and adjacent to construction zones, the possibility exists that these routes may be affected by a construction incident or related activity. Should this occur, alternate routes will need to be employed. To prepare for this possibility, hazardous cargo vehicle route alternatives will be developed for each construction contract as part of the emergency response plan for the contract. These route alternatives will then be submitted in advance to the appropriate local emergency planning committee for approval.

5.3 MATERIALS DISPOSAL

Preliminary estimates of the volumes of dredged and excavated materials for Scheme Z and the alternatives have been developed to determine the most appropriate method of removal of these materials from the site. In addition, materials have been characterized to enable selection of the most appropriate disposal sites. This section describes the materials disposal requirements for each of the four designs. The preliminary estimates of total volumes are shown in Table 5.1.

Table 5.1 Preliminary Estimated Total Of Materials Disposal Volumes (in cubic yards)			
Design	Dredged Material	Excavated Material	Total Volume
Scheme Z	51,000	103,000	154,000
8.1D Mod 5	168,000	917,000	1,085,000
Reduced River-Tunnel	145,000	607,000	752,000
Non-River-Tunnel	44,000	450,000	494,000
Source: Bechtel/Parsons Brinckerhoff			

5.3.1 Dredged Material

5.3.1(a) Characterization And Volume

Dredged material consists of underwater materials to be removed for bridge piers and footings under all four designs. In addition, dredged materials are removed from the river tunnel sections, graving basin, and utility relocations for Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative. Dredged materials are characterized in this report as either acceptable or unacceptable for unconfined ocean disposal at the Massachusetts Bay Disposal Site (MBDS). A preliminary chemical characterization of an earlier river tunnel alignment, conducted in 1992, found that the Charles River organic sediment layer contains consistent Category 3 levels of heavy metals and PCBs, as characterized by the Massachusetts Dredged Material Classification Program pursuant to criteria contained in 314 CMR 9.00. Those Category 3 sediments are not suitable for ocean disposal. Only arsenic and nickel were found to be consistently below Category 3 levels. Sediments were tested for such chemicals as priority pollutant metals, petroleum hydrocarbons PHC, PAH, and PCBs. Based on the above data, it is assumed that the top 8 feet of soft sediments in the Charles River may be unacceptable dredged material. Further testing and characterization will segregate unacceptable dredged material into material which can be reused on site or must be disposed at other locations.

Preliminary estimates of acceptable and unacceptable dredged materials quantities for each design are shown in Table 5.2. These quantities are based upon the construction method described in Section 5.1.2.

Table 5.2 Preliminary Estimates Of Dredged Material Acceptable And Unacceptable For Ocean Disposal At The MBDS (in cubic yards)		
Design	Acceptable	Unacceptable
Scheme Z	41,000	10,000
8.1D Mod 5	138,000	30,000
Reduced River-Tunnel	119,000	26,000
Non-River-Tunnel	36,000	8,000
¹ All assumed unacceptable in the 1991 FSEIS/R; revised figures are based upon subsequent characterization. Source: Bechtel/Parsons Brinckerhoff		

5.3.1(b) Disposal Alternatives

Disposal alternatives for unacceptable dredged material were analyzed in the 1991 FSEIS/R (Part IIB, Chapter 4, Section 4.7). Disposal site alternatives are limited for unacceptable dredged material because of the material's chemical contamination, water content, and salt content. Disposal site alternatives analyzed included the unconfined ocean disposal at the MBDS, confined aquatic disposal (CAD) options such as Spectacle Island, Hull Bay, and the Logan Airport north and west borrow pit sites; and upland sites including Spectacle Island, the Neponset Drive-in/Hallet Street landfill, Squantum Point, Governors Island (Logan Airport), and the Lynn Harbor Transcontinental Development Corporation (TDC) site. The disposal option for the unacceptable dredged material in the 1991 FSEIS/R was upland disposal at Spectacle Island.

It is anticipated that unacceptable dredged material will not be heavily contaminated and could be used as fill within the Project area. This use would minimize truck or barge traffic. Unacceptable dredged material could be placed in the graving basin or Millers River and capped with clean fill. Stabilizing this material could make it suitable for disposal at other upland locations. Because a large volume of unacceptable dredged material will be removed early in the construction phase for the Reduced River-Tunnel Alternative and Alternative 8.1D Mod 5, a stockpile location may be required until the graving basin is decommissioned and filled. Potential stockpile locations include an MDC-owned parcel in the North Point area of East Cambridge and the railroad yards in Somerville.

Acceptable dredged material will be transported by barge and disposed of at the MBDS. The existing locks at the Charles River dam limit the size of barges which can pass through the locks. An ocean dump scow cannot traverse the locks; therefore, smaller deck barges will need to be used for transport of the dredged material through the locks. The dredged material would then be transferred from the deck barges to the larger ocean dump scow at a location in the Harbor outside of the Charles River basin. Alternatively, the dredged material could be loaded onto trucks at a location on the riverbanks and trucked to a barge loading location in the Harbor for loading onto an ocean dump scow. Because of the high water content of the dredged material, it would need to be dewatered prior to loading into trucks, or placed in watertight trucks for transport to the barge loading location.

5.3.2 Excavated Material

5.3.2(a) Volumes

Excavated material consists of materials landward of mean high water to be removed for the land tunnels, boat sections, and viaduct column supports. Such excavated materials in the Charles River crossing area include both native clay and till and historic fill materials. Excavation quantities have been estimated for each of the three alternatives as shown in Table 5.3. For comparison, excavation quantities for Scheme Z are included.

Table 5.3					
Preliminary Estimates Of Excavated Material (in cubic yards)					
Design	Granular Historic Fill	Nongranular Historic Fill	Clay/Till	Organics	Asphalt/ Waste
Scheme Z	40,000	27,000	33,000	45,000	6,000
8.1D Mod 5	234,000	166,000	199,000	266,000	46,000
Reduced River-Tunnel	168,500	116,500	142,500	194,000	26,000
Non-River-Tunnel	133,000	92,000	113,000	154,000	20,000
Source: Bechtel/Parsons Brinckerhoff					

Excavated materials for the Charles River crossing include both native clay and till and historic fill materials. Historic fill comprises the upper layer over the Charles River crossing Project area. Beneath the fill layer lies a band of silts, mud, and sand that comprised the surface materials of the Harbor and the Charles River estuary at the time of European settlement. Below these materials are layers of Boston blue clay and glacial till with the till generally overlaying the clay. Beneath the till is bedrock. Depth to bedrock is shallow on the Cambridge side of the alignment.

When fill materials were placed in the Charles River to fill the Boston and Cambridge banks to their present boundaries, the fill material was mixed with the layers of muds, silts, and sands. As shown in Table 5.3, considerably more fill is required to be removed for the two river-tunnel alternatives compared to the Non-River-Tunnel Alternative.

5.3.2(b) Native Clay And Till

The 1991 FSEIS/R proposed landfill capping as a beneficial reuse for excavated native clay and till. This beneficial reuse is also proposed for clay and till excavated for the Charles River crossing. Intermixed clay and till materials would be distributed to DEP-approved landfill closure sites.

The NPC stated that MHD was investigating alternative sites for a Materials Processing Operation (MPO) in the Charles River crossing area. Subsequent investigations have determined that an MPO facility in the Charles River crossing area is not warranted. The relatively small quantities of excavated material could not be handled as economically in a smaller MPO as they could be at the proposed South Boston MPO which will process the majority of Project excavated material. There is ample capacity at the proposed South Boston MPO to handle even the quantities of excavated material under Alternative 8.1D Mod 5, the alternative which generates the largest quantity of excavated material.

The preferred plan is to truck the excavated material to the proposed MPO site located in South Boston to be processed along with the rest of the excavated clay and till from other areas of the Project. Trucks would travel to I-93 southbound, then proceed to the South Boston Bypass Road and to the MPO site off Congress Street.

An analysis of truck traffic leaving the site of excavation and travelling to the MPO site in South Boston has shown that impacts to local streets in Cambridge and Charlestown are negligible. Roughly 50 percent of excavation occurs on either bank of the Charles River, so local truck impacts are distributed equitably. Excavation truck trips are a small portion of total construction traffic.

5.3.2(c) Historic Fill

The 1991 FSEIS/R also proposed that excavated historic fill be processed at the proposed MPO site in South Boston for beneficial use as landfill cover or Project backfill. All MPO output is subject to multiple testing criteria for chemical contamination in accordance with a February 5, 1993, Memorandum of Understanding between MHD and DEP. MPO output will meet these chemical limits for the specific end use as either landfill cover or backfill.

Nongranular historic fill will be processed for use as cover material and marketed to solid waste landfills, as described in the February 5, 1993 Memorandum of Understanding with DEP. Granular historic fill material will be processed to meet physical specifications for use as backfill along the Project alignment. Construction of any of the three new alternatives will require backfill quantities ranging from 201,000 cy (Non-River-Tunnel Alternative) to 352,000 cy (Alternative 8.1D Mod 5). Scheme Z does not require appreciable amounts of backfill. Potentially, all of the Charles River crossing backfill requirements could be met through the use of excavated historic fill from the alignment. Granular historic fill which cannot be processed for use as backfill can be processed for use as landfill cover or shaping material.

Historic fill and clay and till could be used to close and cap abandoned landfills such as the City of Boston landfill at the Hallet Street/Neponset Drive-in site. Environmental impacts of the use of the Hallet Street/Neponset Drive-in site were analyzed in the 1991 FSEIS/R.

An alternative option for disposal of excavated historic fill material from the Charles River crossing is transport and disposal to out-of-State landfills. DEP has opposed the use the limited remaining in-State landfill air space for disposal of excavated historic fill material from the Project.

5.3.2(d) Organics, Waste Material, And Asphalt

Various quantities of organic, nonsoil solid waste, and asphalt paving materials are expected to be part of the excavated materials for any of the Charles River crossing alternatives. Organic materials include untreated timber pile fragments, wood, stumps, and peat, but specifically excludes any material defined as solid waste under State regulations. Waste materials include manmade objects, such as chemically treated timber piles, metals, plastics, and other similar materials.

Although not specifically analyzed in the 1991 FSEIS/R, organics, waste material, and asphalt were assumed to be part of the excavated historic fill (see Part II Chapter B4). As such, the 1991 analysis of historic fill disposal and reuse options included these material types. Organic materials can be processed for reuse or disposed of at landfills. Asphalt material can be recycled at an asphalt recycling facility for reuse in either cold patch or hot mix asphalt products. Waste materials are planned to be disposed of at Massachusetts landfills.

5.3.3 Conclusion

Scheme Z has the least materials disposal requirements of the four designs. All of these disposal options have negligible differences in impacts. There are comparable opportunities for beneficial reuse in all four designs.

Excavated materials from any of the designs will be transported to the proposed South Boston MPO site for processing into Project backfill (granular fill) or landfill cover or shaping material (nongranular fill) or for distribution to municipal landfills to be used in DEP-approved landfill closures (clay/till). If markets for these materials prove unavailable when required for disposal of this material, the excavated soil would be transported out of State for disposal in landfills or other authorized disposal locations. Organic and waste materials will be properly disposed of by Central Artery/Tunnel contractors.

Dredged materials will be disposed of in accordance with regulatory requirements. Disposal options for the dredged materials unacceptable for ocean disposal from the Charles River include placing the stabilized dredged material in the portion of the Millers River basin which will be filled to create the surface roadways, and stockpiling dredged material at an upland location for later use in the filling of the graving basin of the Charles River under the river.

Acceptable dredged materials from the Charles and Millers Rivers will be transported by barge for disposal at the MBDS.

5.4 LAND USE IMPACTS

Construction period impacts on land use will be primarily noticeable south of the Charles River and will be similar for Scheme Z and the three new alternatives. The timing of future developments will affect the degree of impact.

As discussed in Section 4.2.1, each of the three alternatives will require underpinning of the Massachusetts Registry of Motor Vehicles building at 100 Nashua Street. All of the alternatives may also require underpinning of historic residential buildings along Stillman Place in the North End.

All of the new alternatives will affect the timing of development on the Massachusetts General Hospital development parcel along Nashua Street. With the exception of Scheme Z, the new ramps under the MBTA commuter railroad air rights garage parcel will affect the timing of this proposed development in all of the alternatives.

Construction of the Non-River-Tunnel Alternative will temporarily complicate access to the new Suffolk County Jail due to relocation of Nashua Street. None of the other alternatives will affect access to this facility.

Spaulding Rehabilitation Hospital will be taken under all new alternatives. Due to the need for construction staging areas, development of the Nashua Street parkland parcel will be delayed under all alternatives including river tunnels. Development of any new parkland in the Lower Charles River Basin will be coordinated with construction under the four designs.

5.5 ECONOMIC IMPACTS

Since the publication of the FSEIS/R in November 1990, the economy of the region has continued to weaken significantly. For the past 4 years, all sectors of the regional economy have experienced some

form of slowdown, with job losses occurring in many of the region's traditionally strong industry sectors such as high technology and computer manufacturing. These industry losses, coupled with a more widespread slowdown nationally, have affected economic activity in the study area far more than potential impacts of Project construction. It is important to place in this context any retail, office, or industrial businesses losses which may have occurred in the study area since the start of Project construction activities in 1991. In fact, in light of recent job losses in the regional economy, the jobs being created by the construction of the Project have gained in relative importance to the region's economy.

Construction activities associated with the three new design alternatives for the river crossing will affect three buildings in the Area North of Causeway Street: Spaulding Rehabilitation Hospital, 100 Nashua Street (the Massachusetts Registry of Motor Vehicles), and the Boston Thermal Energy Corporation's Minot Station steam generating plant. All three new alternatives require the taking of the Spaulding Rehabilitation Hospital. MHD will cooperate with MGH and City of Boston to relocate the hospital nearby. The Registry is already planning to move its operation to Parcel 18 in Roxbury by mid-1994, so its operations will not be affected by construction of the river crossing under any alternative. The 100 Nashua Street building would remain, but be underpinned to allow land-based tunnel construction beneath it. This building could be rehabilitated for another economically viable use. The future relocation of Boston Thermal's Minot Station function is somewhat uncertain under all the three new design alternatives. The existing plant building will be displaced by all three alternatives.

Construction activities associated with all the design alternatives may potentially create a marginally greater temporary impact on North End businesses than Scheme Z. This is due to the addition of the New Sudbury Street on-ramp to I-93 northbound and the connection of the Summer Tunnel to Storrow Drive by transferring some local traffic to the interstate system. As discussed in detail in the FSEIS/R, the construction activity may affect businesses located in the vicinity by hindering access for employees and customers, thereby potentially affecting the ability to operate a business in that location, and therefore result in lost sales or income. The extent to which any given business would be affected depends on its exact location, the nature of its product or service, the mode of access for customers and employees, and whether the business has primarily pass-by customers or those who come to the establishment as a destination. As under Scheme Z, it is anticipated that traffic maintenance, signs, and adequate parking will assist in countering those potential temporary impacts during construction. This will be consistent with ongoing construction mitigation commitments.

Construction of the three design alternatives may also temporarily affect the Leverett Circle area. In each alternative, the addition of land-based tunnels under North Station will result in greater complexity of construction, and therefore may temporarily affect economic activity in the area. In addition, the Reduced River-Tunnel Alternative and Alternative 8.1D Mod 5 include a new tunnel, which would result in a potentially even greater impact on Leverett Circle, due to its location and its complexity. As described above, the increased impacts on Leverett Circle could affect businesses located in the vicinity, as it would hinder access of employees and customers and possibly result in a loss of sales or income. The extent to which the construction methods proposed in the three alternatives result in such potential temporary impacts depends on the effectiveness of construction mitigation measures implemented.

5.6 CULTURAL RESOURCES IMPACTS

The following sections describe short-term, temporary construction period impacts of the three alternatives on historic and archaeological resources, as compared to Scheme Z.

5.6.1 Historic Resources

5.6.1(a) Background

In order to mitigate construction period effects, Stipulations 1 through 4 of the 1984 Section 106 Memorandum of Agreement continue to apply to the Area North of Causeway Street and to those parts of the Central Area that are affected by design changes for the Charles River crossing. These stipulations are described in detail in the 1991 FSEIS/R Appendix, Construction Mitigation.

As directed by Stipulation 4 of the MOA, all potential adverse effects from construction (such as vibration and soil movement impacts) will be mitigated through review of design and construction specifications by the Project Conservator. In consultation with the Section 106 agencies during the spring of 1993, MHD has developed standard procedures for the review of historic resources throughout design and construction work. This mitigation effort applies to all adverse effects identified in the list of historic resources below.

As further detailed in the above-referenced Appendix, the following construction procedures will also be applied:

- **Vibration:** Historic structures within 12 feet of slurry wall construction will be carefully inspected before design work is complete, and will be monitored and/or otherwise protected during construction.
- **Pile driving:** Alternative methods will be considered for pile driving operations that occur within 110 feet of historic structures.
- **Monitoring of groundwater and soil conditions:** In areas of deep excavation, such as between North and Causeway Streets, hydrostatic uplift may affect historic structures. Monitoring of groundwater and soil conditions will therefore be undertaken, and special construction methods such as slurry walls or steel sheetpile walls may also be used to reduce lateral movements, settlement, and groundwater influx.

5.6.1(b) Impacts And Mitigation

Specific short-term impacts during construction on the affected resources are described below.

Phipps Street Burying Ground. Because of its distance from the alignment in all four designs, no construction period impacts to this historic property are expected.

Town Hill District. Scheme Z, the Reduced River-Tunnel Alternative, and the Non-River-Tunnel Alternative have no temporary construction period impacts to the historic attributes of this district. Alternative 8.1D Mod 5, however, might have construction period impacts, due to the routing of a northbound tunnel to I-93 within 100 feet from Rutherford Avenue, which forms the southern boundary of the district. In the three alternatives, construction is farther away from the district than the existing I-93 highway structure.

15-18 City Square. Because of its distance from the alignment in all designs, no construction period impacts to this historic building are expected.

Charles River Basin District. The reconfiguration of Leverett Circle in all four designs may have temporary construction period impacts on the historic Street Railway Viaduct, which carries the MBTA Green Line. In Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative, this structure may

also be temporarily affected by the construction of new tunnels within 10 to 15 feet of the southernmost pier. Although slurry wall construction is likely to have no structural impacts on the viaduct, underpinning could be required after further study during design development to mitigate potential construction period impacts.

In all four designs, a new sewer pipe is located about 100 feet from the MDC Police Headquarters and Lock House, and reconstruction of the surface of O'Brien Highway will take place in front of this structure. No construction period effects to the historic building are expected.

The historic Charles River dam, upon which the Museum of Science is built, is located within the secondary corridor of the Project area. No construction work is planned in its vicinity, however, and it is too far away from other activities to be affected during the construction period.

Charlestown/North Washington Street Bridge. Because of its distance from the alignment in all four designs, no construction period impacts to this historic structure are expected.

Granite Seawalls In The Lower Basin Of The Charles River. Construction of bridge footings for all four designs, as well as construction of the river tunnels in Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative, affect the granite seawalls in this area. The Project Conservator will review the design and construction specifications for work in this area. Construction-related adverse effects will also be mitigated through Stipulation 2 of the MOA, which governs similar work at Fort Point Channel. This stipulation describes specific design guidelines for the reuse of existing material and for the characteristics of new construction. Any areas of the seawalls to be disturbed during construction would be carefully removed and stored prior to the commencement of activity in this area.

Tower A. Under the CANA project connection to Scheme Z, Tower A is demolished; Scheme Z has construction period impacts related to the placement of new viaduct ramps 2 to 4 feet over this building. Alternative 8.1D Mod 5 has temporary construction period impacts by routing a tunnel structure directly under a portion of the building. Underpinning is required and constitutes a potential adverse effect during construction. The Reduced River-Tunnel Alternative locates a tunnel within 15 feet of the building. Although slurry wall construction is likely to have no structural impacts on Tower A, underpinning may be required, after further study during design development, to mitigate potential construction period impacts.

100 Nashua Street. Scheme Z has no construction period effects on this historic building. All three alternatives have greater temporary construction impacts than Scheme Z, due to the location of a tunnel directly underneath the building. Underpinning is required and constitutes a potential adverse effect during construction. As mitigation, the deteriorating facade system will be stabilized before construction begins or, if necessary, it will be removed in whole or in part before underpinning occurs.

The Non-River-Tunnel Alternative could have additional adverse construction period effects from the routing of a tunnel from the Central Artery northbound to Nashua Street and Storrow Drive within 50 feet of the northeast corner of the Registry building.

Causeway/North Washington Streets District. In the 1991 FSEIS/R, all buildings rated with a potential for medium to high impact by the Project Conservator are determined to be adversely affected by the construction of the northbound I-93 mainline tunnel in Scheme Z.

In all three alternatives, northbound tunnels pass closer than Scheme Z to historic buildings, including within 15 to 25 feet of the Charles River Building, Braman Dow Building, and 6-24 Medford Street (all

of which the Project Conservator rated medium to high in potential impact). Although slurry wall construction is likely to have no structural impacts on these buildings, underpinning may be required after further study of existing conditions during design development.

Bulfinch Triangle District. In the 1991 FSEIS/R, all buildings rated with a potential for medium to high impact by the Project Conservator were determined to be adversely affected by the construction of the northbound I-93 mainline tunnel in Scheme Z. Similar tunnel construction in all three alternatives will have no change in construction period effects from Scheme Z.

North End District. In the 1991 FSEIS/R, all buildings rated with a potential for medium to high impact by the Project Conservator are determined to be adversely affected by the construction of the northbound I-93 mainline tunnel in Scheme Z. All four designs have potential construction period impacts due to the location of a northbound tunnel within 10 feet of the historic buildings and streetscape at Stillman Place (which was given a very high potential impact rating by the Project Conservator), and within 20 feet of historic buildings at 45-51 and 53-65 North Washington Street (both of which were given a high potential impact rating by the Project Conservator). In all four designs, underpinning of the Stillman Place buildings may be required after further study of existing conditions during design development.

Unlike Scheme Z, the three alternatives also have potential adverse impacts from the construction of the surface road within 10 feet of Stillman Place, which is closer than in Scheme Z. Any historic paving materials or bollards to be disturbed would be carefully removed and stored, prior to the commencement of activity in this area.

5.6.1(c) Summary

Adverse effects during construction are due primarily to construction activities associated with the I-93 mainline tunnels, particularly on the historic districts south of the Charles River. In order to be consistent with the 1991 FSEIS/R, the determination of adverse effect has been carried over to all the historic resources considered in this document. The slurry wall construction proposed for all the tunnels in the affected area is inherently designed to avoid construction-related vibration or movement in adjacent structures. The mitigation procedures established by the 1984 MOA will be applied during design and construction, should any unforeseen conditions arise.

5.6.2 Archaeological Resources

Archival review indicates three potentially significant archaeological resources in the study area north of the Gilmore Bridge: (1) prehistoric sites within the former Millers River embayment; (2) a tide mill at Mill and Essex Streets; and (3) the terminus of the Middlesex Canal at Charlestown Neck. (These sites are described in Section 4.7.2.)

If the selected design involves the Rutherford Avenue off-ramp or collector/distributor roadway, these sites would be subject to more detailed archaeological investigation. If necessary, such investigation would include limited subsurface testing to locate and evaluate archaeological resources. Construction impacts to any significant sites could be avoided by adjusting viaduct footing locations, changing the construction method to one with lesser impacts, or undertaking Phase III data recovery.

Areas with a lower probability of significant and intact resources will be monitored during construction, in accordance with the 1984 MOA, which outlines the Project's commitments to archaeological resources. Should evidence of significant prehistoric or historic period sites be detected during construction, the Project's existing mitigation program, as described in the 1991 FSEIS/R, would go into effect. Such sites

would undergo archaeological salvage work under the terms of the Project's contingency plan, MHC regulations, and the existing MOA.

5.7 UTILITIES

This section summarizes the temporary construction period impacts to utilities for all four designs. Generally, utility facilities are relocated out of the right-of-way before construction begins and are protected during construction if they are not relocated. These precautions are specified in the Project's maintenance of utilities plan and implemented by specifications in construction contracts. There are no long-term impacts to utilities because of these preconstruction and construction period mitigation measures.

Each of the new design alterations requires relocations of many public and private utilities within the Area North of Causeway Street. Scheme Z's impacts on utilities are described in the 1991 FSEIS/R. Utility systems to be relocated include: water, wastewater, drainage, electric, gas, telephone, and steam. Existing utility systems in conflict are kept in service until suitable replacement facilities are constructed and activated. The impacts to major utility systems are identified below. The locations are shown in Figure 5.19. Generally, the two river tunnel alternatives have greater impact to utilities than the non-river tunnel designs because of the locations of major utilities below the river in each river tunnel alignment.

5.7.1 BTEC Minot Station Steam Generating Plant

The Boston Thermal Energy Corporation's (BTEC) Minot Station plant is taken to provide area for ramps at Leverett Circle under the three new design alternatives. It is not taken with Scheme Z. MHD and BTEC have discussed the following mitigation alternatives:

- upgrade the existing steam plant at Kneeland Street to replace capacity
- construct a replacement plant
- relocate existing facilities in the new ventilation building on the south side of the Charles River

Detailed studies of these alternatives are ongoing and will result in a specific mitigation program for BTEC.

5.7.2 BWSC West Side Interceptor And Nashua Street Outfall

The Boston Water and Sewer Commission (BWSC) is concerned about the protection of and maintenance of service of its 72-inch by 90-inch West Side Interceptor (WSI) and its 54-inch Nashua Street Outfall (NSO). Portions of these facilities are relocated under all four designs because of roadway and tunnel work at Leverett Circle, Nashua Street, and Storrow Drive. Additional relocation of smaller BWSC facilities is required for the three alternatives and will be coordinated with the agency.

5.7.3 BECo 345 kV Electrical Transmission Line

Boston Edison Company (BECO) maintains a 345 kV electrical transmission cable system under the Charles River. The purpose of this line is to provide bulk power to downtown Boston. The operation of this line is a function of electrical generation patterns at BECo power plants in Everett and South Boston.

This system must be relocated in the Leverett Circle area because of ramp construction under any of the alternatives. The portion in the Charles River will not be affected by either the Reduced River-Tunnel Alternative or the Non-River-Tunnel Alternative; however, it is relocated under Alternative 8.1D Mod 5. Service will be maintained.

5.7.4 MWRA Combined Sewer Force Main

The Massachusetts Water Resources Authority (MWRA) maintains a combined sewer (CS) 96-inch force main in Cambridge and under the Charles River. This system is relocated in both Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative. It is not affected under the Non-River-Tunnel Alternative because the structural supports for the viaducts can be located to avoid conflicts.

The location of the graving basin on the north bank of the Charles River necessary for constructing the river tunnel sections for Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative must be selected in consideration of the current force main locations.

5.7.5 Other Utility System Conflicts

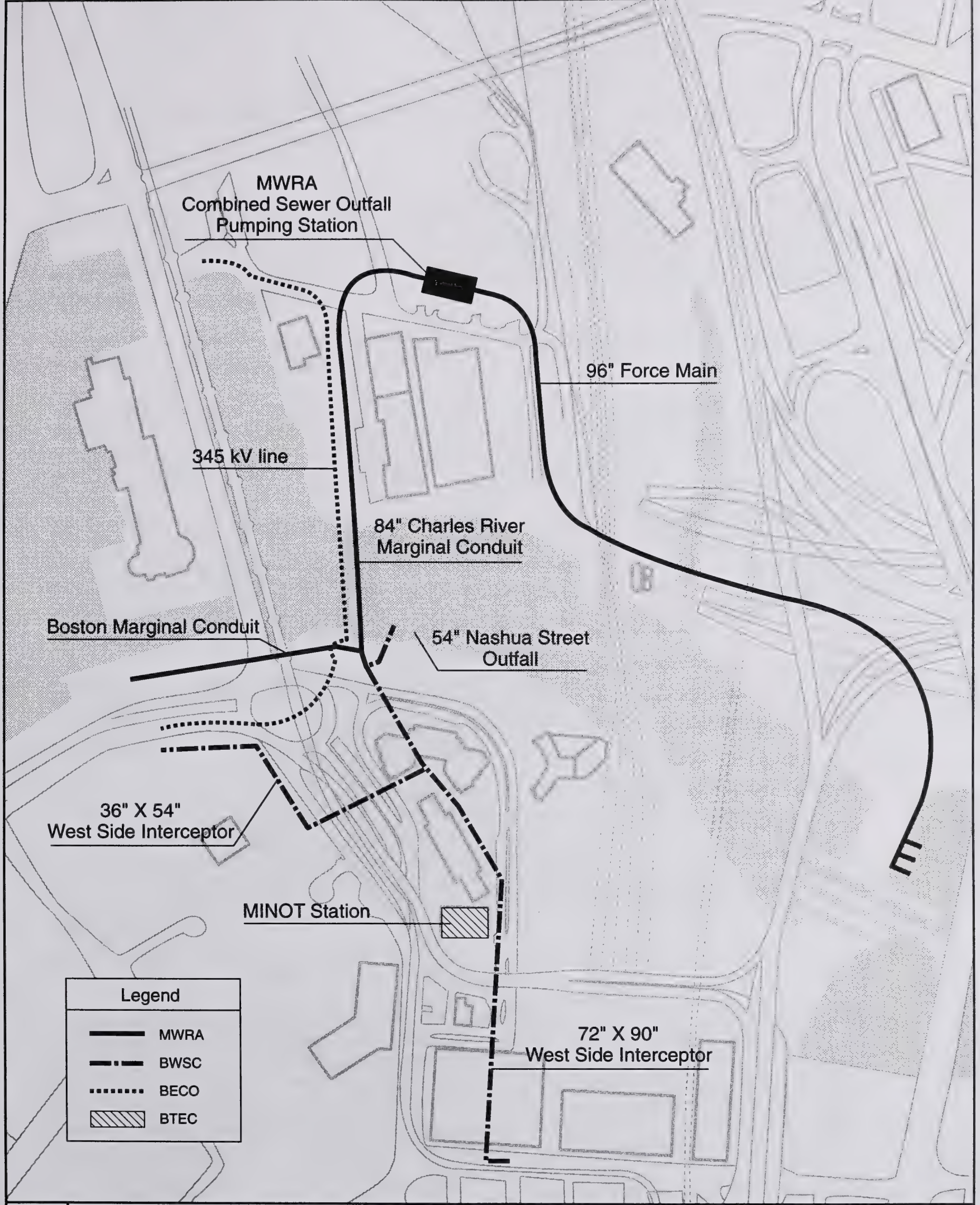
In addition to the major conflicts described above, there are other utility relocations required at Leverett Circle, the CANA loop ramp area, and at Causeway Street/Accolon Way in certain portions of the alignment. The MBTA's Boston Engine Terminal in Cambridge includes three 48-inch force main draining into the Millers River. The construction plans for the new design alternatives will accommodate this drainage.

5.8 AIR QUALITY

Construction-related air quality impacts will be caused by detouring and disrupting traffic (mobile emissions including CO sources), and the demolition, land clearing, grading, excavation, and other earthwork activities (fugitive particulate emissions including fugitive dust sources). The type and nature of these construction activities are not expected to be substantially different for Scheme Z and the alternatives when they are compared to the Central Artery/Tunnel Project as a whole.

The construction-related air quality impacts for the entire Project are being evaluated through a series of analyses, pursuant to the Memorandum of Understanding (MOU) signed by MHD, FHWA, EPA, and DEP as part of the May 1991 Record of Decision of FHWA. The Construction Air Quality Committee, formed for the purpose of evaluating and minimizing these impacts, meets on a regular basis to discuss study methodology, results, and mitigation measures to minimize potential construction-related air quality impacts. This process will be continued throughout the construction of the Project, including the Charles River crossing. The specific construction air quality impacts associated with the preferred alternative will be evaluated under the same ongoing MOU process described above.

The analyses currently being used to estimate construction impacts include a process that: (1) estimates traffic volumes at specific locations during major construction phases (this is part of the maintenance of traffic plans for each construction contract area prior to construction activities); (2) estimates CO levels at intersections likely to be affected by construction detours and truck routing; (3) evaluates areawide emissions; and (4) estimates construction-related dust levels near major construction sites.



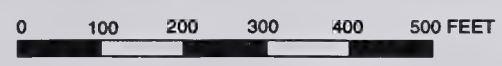
FIGURE

5.19

Location of Existing Major Utilities

Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



5.9 NOISE AND VIBRATION

5.9.1 Impacts

Construction noise and vibration impacts are related to intensity of construction noise and vibration sources and their distance to sensitive receptors. Information on the sources of construction noise and vibration, Project design criteria, and methodology for assessing construction noise and vibration impacts are described in Section 20.2.5 of the 1991 FSEIS/R and in its Noise and Vibration Appendix. This information is not repeated here.

Construction period noise impacts are somewhat less favorable in the three new design alternatives due to tunnel construction not required under Scheme Z.

Construction noise impacts continue, with varying degrees of intensity depending on the particular phase of the work, over a period of 8 to 13 years. Both noise and vibration impacts are felt during the period of construction at adjacent land uses. Construction noise and vibration are determined by the construction techniques employed, equipment used, and phases of construction activity.

The two river tunnel alternatives involve extensive tunneling under and on both sides of the river. Tunneling across the river involves blasting of bedrock. Blasting noise levels depend on the charge weight and depth of rock removed per blast. These repeated impacts potentially affect residents within 1,000 feet during blasting operations. Tunnel construction also generates noise impacts associated with installation of sheet piles for cofferdams and excavation support walls, excavation equipment, trucks, cranes, and other construction equipment. These impacts will be mitigated as required.

Unmitigated Leq (1 hour) noise levels at construction site boundaries generally lie in the range 85 to 90 dBA. Projections of construction site noise levels at other distances can be made according to the methodology described in the 1991 FSEIS/R Noise and Vibration Appendix. The noisiest activities are usually associated with impact pile driving and blasting.

Construction vibration impacts would affect nearby structures depending on distance from the vibrating equipment or blasting operation. The prime focus of this DSEIS/R is on potential structural or cosmetic damage to structures within 110 feet of a vibration source, the distance at which minor cosmetic damage to historic buildings may result from pile driving operations. This is a worst-case analysis, and it predicts unmitigated vibration impacts which will be mitigated as required. The potentially affected buildings and their distances to the tunneling and viaduct construction activities are identified in Table 5.4.

5.9.2 Mitigation Measures

Detailed information on mitigating the adverse construction noise and vibration impacts is presented in the 1991 FSEIS/R and in its Noise and Vibration Appendix. Noise and vibration mitigation will be studied in detail as part of the design and mitigation implementation process for the Charles River parkland and the Charlestown neighborhood. Mitigated noise levels will be consistent with Boston City Noise Code requirements, and mitigated vibration levels will be consistent with the Project design criteria that were compiled from national and international sources. A detailed noise and vibration mitigation program during construction will be developed for the preferred alternative in the Final SEIS/R.

5.10 AQUATIC RESOURCES

5.10.1 Wetlands

Project construction activities result in substantial temporary impacts to Federal and State wetland resources that are in addition to the permanent impacts described in Section 4.5.1. Construction wetland impacts of Scheme Z and the Non-River-Tunnel Alternative result in considerable less areal extent and are of shorter duration than the river tunnel alternatives.

5.10.1(a) Federal Resources

Under all alternatives, nontidal waters in the Charles River are temporarily affected by construction activities including the installation of sheetpile cofferdams, footings, and the construction of piers. In addition, Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative create temporary impacts related to the construction of the tunnel under the river including: dismantling of the existing seawall, installation of circular cells, and restoration of the seawall as part of the graving basin construction; dismantling and reconstruction of the seawall on the north and south sides of the river for the tunnel approaches; dredging and installation of the sheetpile earth containment system and installation of the tunnel segments (see Table 5.5).

Scheme Z has construction related temporary impacts to nontidal waters of the Millers River as a result of installation of sheet pile cofferdams, footings, temporary piers and permanent piers. The Non-River Tunnel Alternative has similar impacts to nontidal waters of the Millers River with additional impacts associated with filling for the access ramps. The river tunnel alternatives (Alternative 8.1D Mod 5 and Reduced River-Tunnel Alternative) result in similar impacts as the other two designs with the addition of the installation of tunnel(s) under the river.

Construction activities do not affect the small area of wetlands on the Charles River located near the inlet of the Millers River.

The southern banks of the Millers River are temporarily affected by the installation of tunnels under the river. These temporary impacts do not occur in Scheme Z or in the Non-River-Tunnel Alternative.

5.10.1(b) State Resources

Bordering Vegetated Wetlands (BVW). Construction impacts to BVW will occur under only two alternatives, Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative as a result of constructing tunnel ramps under the southern portions of the Millers River. These temporary impacts do not occur in Scheme Z or in the Non-River-Tunnel Alternative.

Banks. Construction activities under each alternative affect banks (see Table 5.6). Along the Charles River, these activities include the construction of cofferdams, footings, and the placement of piers to support the I-93 bridges and ramps and, in the case of Scheme Z and the Non-River-Tunnel Alternative, to support the Storrow Drive-to-Tobin Bridge ramps. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative also require the dismantling and reconstruction of seawalls on the north and south banks for the tunnel approaches and along the bank where the graving basin is constructed.

On the Millers River, the three new design alternatives require filling the northern portion of the river, creating temporary impacts on the bank. Alternative 8.1D Mod 5 results in altering an additional bank to construct the S-N and C-T tunnel under the southern portion of the river, and the Reduced River-Tunnel Alternative results in altering additional banks to construct the S-T and S-N tunnels across the river in its southerly and central portion.

Table 5.4

BUILDINGS POTENTIALLY AFFECTED BY CONSTRUCTION VIBRATION

Tunnel Construction (i.e., pile driving) ¹						
ID# ²	Name	Approximate Address	Approximate Distance (ft.) ¹			
			Scheme Z	8.1D Mod 5	Reduced River-Tunnel	Non-River-Tunnel
O.7	Hoffman Building	Lovejoy Wharf	110	90	90	80
O.8	Stop and Shop Building	226-246 Causeway Street	110	50	60	50
O.13	Anelex building	146-154 Causeway Street	110	110	110	110
H.25	Amy Lowell House	65 Martha Road	-	40	-	-
H.26	Charles River Park apts.	Martha Road/Amy Court	-	65	-	-
H.31	Charles River Park apts.	333 Charles Street	-	-	110	110
H.32	Charles River Park apts. swimming pool	389 Charles Street	70	-	80	80
G.33	Registry of Motor Vehicles	100 Nashua Street	-	tunnel under building	tunnel under building	tunnel under building
G.34	Suffolk County jail	200 Nashua Street	-	40	110	100
G.35	Spaulding Rehab. Hospital	125 Nashua Street	-	tunnel under building	60	60
H.36	Northern Terminal warehouse	North Point/Boston and Maine railroad yard	-	40	-	-
H.38	Northern Terminal warehouse	North Point/Boston and Maine railroad yard	-	20	110	-
Viaduct Construction ¹						
G.12	future Boston Garden	88-118 Causeway Street	65	70	95	-
G.33	Registry of Motor Vehicles	100 Nashua Street	110	40	-	-
H.38	Northern Terminal warehouse	North Point/Boston and Maine railroad yard	20	90	60	55
G.42	Northern Terminal warehouse	North Point/Boston and Maine railroad yard	25	40	40	40
O.43	Northern Terminal warehouse	North Point/Boston and Maine railroad yard	60	45	70	70
G.49	Bunker Hill Community College	New Rutherford Avenue	100	100	100	100

Source: Bechtel/Parsons Brinckerhoff

¹ Buildings within 110 feet of construction are potentially affected by construction vibration.² See Figure XXX for location of sites.

Table 5.5

TEMPORARY IMPACTS TO FEDERAL WETLAND RESOURCE AREAS

	Scheme Z ¹	Alternatives		
		8.1D Mod 5 ²	Reduced River-Tunnel	Non-River Tunnel
Charles River				
nontidal water (acres)	0.40	1.4	1.4	0.20
wetlands (acres)	N/A	N/A	N/A	N/A
Millers River				
nontidal water (acres)	0.25	0.40	0.70	0.25
wetlands (acres)	0.01	0.04	0.05	0.02

¹ The impacts have been recalculated to reflect current pier dimensions and construction methods for the Millers River, thus differing from those included in the 1991 FSEIS/R.

² The impacts have been recalculated to reflect current construction methods, thus differing from those included in the Notice of Project Change.

Table 5.6

TEMPORARY IMPACTS TO STATE WETLAND RESOURCE AREAS

	Scheme Z ²	Alternatives		
		8.1D Mod 5 ³	Reduced River-Tunnel	Non-River Tunnel
Charles River				
bordering vegetated wetland (acres)	N/A	N/A	N/A	N/A
banks (linear feet)	100	660	620	90
land under water (acres)	0.40	1.4	1.4	0.20
land subject to flooding (acres) ¹	N/A	N/A	N/A	N/A
Millers River				
bordering vegetated wetland (acres)	0	0.0010	0.002	0
banks (linear feet)	140	390	380	100
land under water (acres)	0.30	0.40	0.04	0.01
land subject to flooding (acres)	0.02	0.02	0.04	0.010

¹ Presumptions of significance for this do not apply.

² The impacts have been recalculated to reflect current pier dimension and construction methods for the Millers River, thus differing from those included in the 1991 FSEIS/R.

³ The impacts have been recalculated to reflect current construction methods, thus differing from those included in the Notice of Project Change.

Land Under Water (LUW). Land under water in the Charles River is temporarily affected by construction activities including the installation of sheetpile cofferdams, footings, and the construction of piers. In addition, Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative create temporary impacts related to the construction of the tunnel under the river, including: dismantling of the existing seawall, installation of circular cells, and restoration of the seawall as part of the graving basin construction; dismantling and reconstruction of the seawall on the north and south sides of the river for the tunnel approaches; dredging and installation of the sheetpile earth containment system, and installation of tunnel sections (see Table 5.6).

LUW in the Millers River has construction related temporary impacts during installation of sheet pile cofferdams, footings and piers, filling for the access ramps, installation of surface roads, and installation of tunnels under the river. These temporary impacts vary according to the specific alternative (see Table 5.6).

Bordering Land Subject To Flooding (BLSF). Construction activities result in temporary effects to bordering land subject to flooding along the Millers River (see Table 5.6). Activities include the construction of cofferdams for footings on land and, under Alternative 8.1D Mod 5, tunnel construction under the Millers River. In addition, BLSF in the Millers River is further affected as a result of activities related to filling in the northern portion of the river.

The proposed activities have no effect on flood storage or storm damage, as the Charles River dam controls the flood level of these water bodies. Unlike Scheme Z, the new design alternatives result in a net increase in flood storage capacity.

Mitigation Measures. Various construction techniques minimize adverse impacts to wetlands resource areas. The proposed construction of bridge piers, including removal of bottom material, occurs within cofferdams to confine in-water activities. It is anticipated that those bridge piers which will be located within 50 feet of the shoreline are constructed from land.

Two of the alternatives, Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative, require the installation of tunnels beneath the existing river bottoms of both the Charles River and the Millers River. This activity could be accomplished using a master pile/sheet pile arrangement as described in Section 5.1 to both minimize turbidity and the volume of dredging. Construction of the tunnels may require the construction of a graving basin. Pier and tunnel construction requires dismantling and subsequent reconstruction of seawalls and dredging activities. Silt curtains will be employed to minimize turbidity.

Summary. Scheme Z and the Non-River-Tunnel Alternative have less temporary construction impacts on wetland resource areas than Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative.

5.10.2 Waterways Impacts

Various construction related activities result in temporary impacts to flowed waterways resources including installation of cofferdams, footings and piers, and removal of existing piers and structures. In addition, the alternatives which include in-water tunnel activities (Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative) require extensive dredging and dredge material disposal, installation of tunnels, construction of a casting basin on the north bank of the Charles River, and dismantling and reconstructing existing seawalls. Temporary impacts to filled tidelands also occur during construction of surface roads, viaducts, cut-and-cover tunnels, and ventilation buildings; relocation and installation of utilities; and demolition and underpinning of various structures.

5.10.2(a) Flowed Tidelands

Construction activities temporarily affect the Charles River. Scheme Z and the three new design alternatives require the demolition of the existing I-93 bridge over the Charles River and removal of all but one pier. Construction of new bridge piers in the river requires the installation of sheet pile cofferdams around the proposed pier locations to facilitate the construction of footings and piers. All footings in the river are placed below the mudline. Potential navigational impacts caused by pier construction are greater with a two-tower mainline bridge as in the Reduced River-Tunnel Alternative and Non-River-Tunnel Alternatives than in a single tower bridge alternative. A navigation plan will be developed in conjunction with the U.S. Coast Guard as described in Section 5.10.3.

The Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative, also temporarily affect the Charles River due to the placement of the tunnel. While the tunnel is being placed, approximately one-half of the river channel will be out of use, creating temporary effects to navigation (See Section 5.10.3). Approximately 95,000 cubic yards (cy) of material within a 57,000 sf area is dredged to facilitate the installation of tunnel sections for the Alternative 8.1D Mod 5 and 60,000 cy within a 36,000 sf area for the Reduced River-Tunnel Alternative. The tunnel placement for Alternative 8.1D Mod 5 requires approximately 270 linear feet (lf) and 150 lf of existing seawalls (banks) along the north and south bank of the Charles River, respectively, to be dismantled and subsequently reconstructed. For the Reduced River-Tunnel Alternative, 140 lf of seawall on the north bank and 90 lf of seawall on the south bank will be temporarily dismantled and subsequently reconstructed. The construction of the casting basin on the north side of the river requires the dismantling of the approximately 240 lf of seawall, installation of 35-foot diameter circular cofferdams, and subsequent reconstruction of the seawall. Pier construction under Scheme Z and the three new design alternatives, will require dismantling and reconstruction of seawalls in the affected area.

In the Millers River, construction impacts result from the installation of bridge and ramp piers as well as ramp tunnels under the river bottom. Unlike Scheme Z, the three new design alternatives require construction activities associated with filling in the northern portion of the river to accommodate the access ramps.

5.10.2(b) Filled Tidelands

Construction related temporary impacts to filled tidelands occur as the result of construction of surface roads, viaducts, cut-and-cover tunnels, and ventilation buildings; relocation and installation of utilities; and demolition and underpinning of various structures. Scheme Z and three new design alternatives require the demolition of the existing I-93 bridge over the Charles River, and all of the alternatives except for Scheme Z require the removal of existing CANA ramp stubs C-L and T-C, as a result of redesign. Construction of ventilation building(s) and associated ducts is also required under each alternative except Scheme Z.

Public access will be maintained from Causeway Street across the Charles River Dam to City Square in Charlestown throughout construction. Vehicular access to the MDC, MBTA Railroad Bridge and MDC Gridley Locks and Dam will be maintained. However, all other areas of the Charles and Millers Rivers within the limits of construction will be closed for public safety reasons.

Both Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative require the construction of a 200-foot-wide, 35-foot-deep, and 400-foot-long casting basin along the northern bank of the Charles River. Accordingly, approximately 117,000 cy of materials will be excavated. This basin will be filled upon completion of the Project.

Summary. Scheme Z and the three new design alternatives cause temporary impacts due to the construction of piers in filled and flowed tidelands. Between the bascule bridge and the new MDC dam, Scheme Z and the Non-River-Tunnel Alternative have slightly greater impacts due to the construction of a second bridge. Considerably greater temporary impacts occur between the old dam and the bascule bridge under both river tunnel alternatives. Neither Scheme Z nor the Non-River-Tunnel Alternative have any temporary impacts in this area.

5.10.3 Navigation

Bridge and tunnel construction will be coordinated to minimize impacts to navigation in the Charles River. Navigation plans and blasting plans will be prepared to detail the schedule and methods employed to minimize impacts on both recreational and commercial traffic. These plans will be submitted to regulatory agencies and the appropriate community for review. Regardless of which alternative is selected for final design, the mitigation measures stated in the 1991 FSEIS/R will be honored. MHD will work closely with the US Coast Guard in further development of construction planning. Permanent navigation impacts are described in Section 4.5.3.

5.10.3(a) Impacts Related To Bridge Construction

The construction period is estimated to be 4 years. The first phase entails dredging, cofferdam construction, and the pouring of concrete for two approximately 74-foot by 74-foot footings located partially in the water on the north and south banks of the river, for main bridge and pier construction. The southern cofferdam extends into the waterway 40 feet beyond the fender pier line, requiring the temporary removal of approximately 100 feet of fender line. This could result in the temporary closure of the southernmost recreational lock for brief periods during construction. Cofferdam construction of the northern pier intrudes 40 feet into the waterway but remains behind the fender pier line, not intruding into the railroad bascule bridge channel. Commercial and recreational traffic is maintained through the remaining locks and through the bascule bridge during bridge pier construction.

Once the bridge piers are completed, construction of the deck span begins. This work may be constructed from equipment mounted on the bridge structure or from equipment secured to barges located in the water. If the bridge is erected from below, two barges capable of supporting 300-ton cranes are required for the construction of the bridge superstructure. These barges typically measure 90 feet by 120 feet. A smaller barge measuring 30 feet by 90 feet supplies the steel spans that form the deck. During the lifts of the deck spans, the flow of commercial and recreational boat traffic through the locks may be curtailed because of construction in and over the waterway. Although each lift may take up to 6 hours, positioning the equipment in the waterway may take a day's time, making it inefficient to move the equipment out after each lift. Therefore, the navigation plan will address the most efficient method of constructing the deck span with the least impact on navigation.

Even if smaller barges, which do not obstruct the waterway, prove capable of sustaining the crane loads, temporary closure of the waterway will be needed during lifts over the navigation channel for safety reasons. All temporary closures would be closely coordinated with the USCG, the MDC, the Harbormaster, and the boating community.

As final design proceeds and more is known about bridge fabrication, the best available technique for bridge construction will be identified. The goal for this construction is to keep the Charles River channel open for navigation to the fullest extent possible.

After the deck spans are installed, finish work on the bridge entails cable fastening, riveting, welding, surface paving, installation of guard rails, and painting. Netting is strung immediately under the deck

to contain all materials without compromising vertical clearances. Although construction design and coordination generally allows boat traffic to proceed throughout the period of bridge finish work, there may be instances in which caution dictates temporary closure. Again, these closures will be scheduled to minimize impacts on the boating community. Details of seasonal accommodations, methods of vessel traffic management, overall safety measures, and the coordination with public agencies will be stated in the navigation plan.

Construction period planning will consider the entire navigational system between the Longfellow Bridge and the MDC locks. Currently this system includes boat holding areas on either side of the bascule bridge; however, during certain construction phases the holding area between the bascule bridge and the MDC locks will be unavailable. For Scheme Z and the Non-River-Tunnel Alternative boats will be held upriver of the bascule bridge. For Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative, boats will be held upriver of the old MDC locks. For any alternative, boats will be guided through the construction area. Specific details of accommodating recreational and commercial boat traffic will be discussed in the navigation plan, and will be reviewed by all relevant agencies.

5.10.3(b) Impacts Related to River Tunnel Construction

Subaqueous tunnel construction associated with Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative affects the free flow of vessels in the Charles River. The immersed tube tunnel entails dredging, blasting, foundation preparation, construction of a casting basin for tunnel tubes, transport and placement of the four to six sections of concrete tube sections, and backfilling. Also, cofferdams are needed at either end of the tunnel for the connection of the immersed tube to the landside tunnel sections. Master pile/sheet pile arrangement (vertical excavation support) may be used to provide underwater excavation support during dredging and tunnel placement.

Tunnel construction can be accomplished in stages, with channels marked for safe passage of boats. Channel locations for boat traffic will be determined in conjunction with the USCG and the MDC. The navigation plan will address how this work will proceed so that commercial and recreational vessels can use the waterway throughout tunnel construction with the exception of periods of blasting. The blasting plan will detail the time for such blasting and include plans to avoid impacts to boaters and fish runs.

Dredging to accommodate the new tunnel, may result in increased barge traffic over that identified in the 1991 FSEIS/R. The barges will be quantified in the navigation plan when material volumes, the size of barges, and disposal sites are identified. Any increase in tunnel barge traffic will be offset, however, by some decrease in barge traffic related to the new bridge designs.

Summary. Temporary construction impacts on navigation are related to the number of piers that must be constructed in proximity to the navigational channels. Scheme Z and the Non-River-Tunnel Alternative have marginally greater temporary impacts to navigation than the other two alternatives between the MDC locks and the Bascule Bridge. The River Tunnel Alternatives, however, extend construction period impacts into the area between the bascule bridge and the old MDC dam, which causes additional restrictions to navigation in the lower basin.

5.10.4 Fisheries

The severity of temporary impacts to the fisheries during construction depends largely on the methods used (see Section 5.1., Construction Plan), and any additional steps taken to minimize associated impacts (i.e., mitigation). Construction is expected to have limited, localized effects on the Charles River fisheries for Scheme Z and the three new design alternatives, assuming proper controls are implemented. No effects to fisheries are expected in the Millers River, as this river does not sustain fish or their forage.

The methods proposed for bridge construction address major sources of suspended solids (see Section 5.1.1). Suspended solids could affect the survivorship of larval fish which may not attain adequate nutrition while feeding on non-algal sediment. Because of the low flow and controlled depth of the Charles, a master pile/sheet pile arrangement (vertical excavation support) or silt curtains would be effective in controlling the dispersion of suspended solids from dredging, or from shoreline construction areas. Therefore, only minimal temporary impacts are expected during construction of Scheme Z and the three design alternatives. By controlling turbidity, fish movement would not be impeded, and would be restricted only from areas of dredging and pier construction. Because construction is planned so as not to prohibit navigation, it is expected that fish (including anadromous species) passage would not be affected by any alternative.

Alternative 8.1D Mod 5 and the Reduced River Tunnel Alternative may require blasting operations to construct the tunnel trench. The Charles River dam pool does not have the high flow rates which aid in dissipating underwater blast energy. The low flow in the Charles River will require implementation of stringent controls necessary to protect the diversity of fish found there year-round. Unlike the anadromous herring that were startled from blast areas by high frequency sound during the Third Harbor Tunnel construction, many of the other fish species have not responded to such protection devices. Other methods, however, have been used to deter fish from entering harmful locations, including behavioral stimuli such as strobe lights, pneumatic hammers, electric fields, and bubble curtains, and physical barriers such as nets, steel mesh, and silt curtains. In association with blasting controls a protection system using one or several measures could be developed to minimize the potential harm to fish. Physical barriers, because they are not species selective, may be the most effective measure to protect all species of the pool above the dam. Depending on overpressures generated by blasting, bubble curtains might be used to dissipate blast energy.

Under Scheme Z and the new design alternatives, acceptable dredged material is anticipated to be disposed at the Massachusetts Bay Disposal Site (MBDS) under the existing U.S. Army Corps of Engineers (USACE) permit. MHD in coordination with the USACE, will reinitiate the original Section 7 Consultation in accordance with the Endangered Species Act of 1973 (16 U.S.C. sec 1531 et seq.) to assure that additional quantities of dredged material can be disposed at the MBDS with out affecting endangered or threatened species.

5.10.5 Water Quality

Scheme Z and the three new design alternatives require bridge and viaduct construction which would result in minimal water quality impacts. Each bridge pier is constructed within a cofferdam which will contain disturbed sediments.

Dredging and filling in the Charles and Millers Rivers for the tunnel, footings and roadways have limited localized effects on water quality depending on construction technique and mitigation measures used. To minimize the effects, the contractor will monitor water quality on a regular basis and use such turbidity control measures as turbidity curtains, a closed dredge bucket, and cofferdams. Upon completion of construction, levels of suspended particulates and turbidity are expected to return to normal levels.

As identified in the 1991 FSEIS/R, surface runoff and any excavation dewatering discharge to surface waters or reintroduced into the ground is regulated by DEP and EPA to meet water quality standards. The Project's construction NPDES permit requires site-specific plans for controlling and treating discharges. With those appropriate controls in place, all the alternatives would have minimal water quality impacts.

Construction of a subaqueous tunnel will likely result in increased turbidity due to the greater aerial extent of disturbance. In addition to the mitigation measures described above, a Master pile/sheet pile arrangement may be used. This arrangement provides an enclosed aqueous space for construction activities including dredging to occur.

5.10.6 Other Aquatic Resources

In general, temporary construction impacts on other aquatic resources are not different from those described for permanent impacts in Section 4.5.6. Wildlife impacts are minimal because of the present unsuitability of the area for wildlife. Any temporary loss of floodplain capacity is negligible because the water level in the Charles and Millers Rivers system is controlled by the Charles River dam, and because the Millers River is such a small, downstream tributary of the much larger Charles River system.

The only difference in coastal zone impacts beyond those of Scheme Z is the tunnel construction proposed in Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative. As discussed in Section 5.10.4, tunnel construction is planned so as not to disrupt the anadromous fish run in the river. A consistency certification statement is submitted to the Massachusetts Coastal Zone Management Agency in conjunction with any Federal permits required for the Charles River crossing (see Appendix E).

6. List Of Preparers

Chapter 6

LIST OF PREPARERS

This section briefly describes the responsibilities and backgrounds of the key individuals who were involved in the preparation or review of the Charles River Crossing DSEIS/R for the Central Artery/Tunnel Project.

FEDERAL HIGHWAY ADMINISTRATION

Daniel Berman

Project Manager, Artery/Tunnel Project

Mr. Berman is the principal FHWA representative for the Artery/Tunnel Project, and is responsible for coordination and review of all phases of work. He has over 18 years experience in providing expert counsel to agency management and professional colleagues on a wide variety of planning and transportation issues. He has been with FHWA transportation engineering since 1974, and has worked in both regional and division offices in Louisiana, California, Kansas, New York, Colorado, Rhode Island, and, currently, Massachusetts. Mr. Berman holds a Bachelor of Science degree in Civil Engineering from Lamar University, Beaumont, Texas.

Jeffrey Firman

Environmental Engineer, Planning & Program Development

Mr. Firman coordinated the review and comments of this document by a multidisciplinary team. He has 23 years experience with FHWA in highway design and construction, including assisting in preparation of numerous environmental documents. Mr. Firman holds a Bachelor of Science in Civil Engineering from the University of Maryland and a Master of Science in Transportation Engineering from RPI.

MASSACHUSETTS HIGHWAY DEPARTMENT

Peter M. Zuk

Project Director, Artery/Tunnel Project

Mr. Zuk directs the Artery/Tunnel Project. He brings to these challenges 9 years in private law practice and 4 years with the office of the Massachusetts Attorney General as Chief of the Contracts Division, and later as Deputy Attorney General. Previously, he practiced law in Washington, D.C., concentrating in construction law and civil litigation. In 1991 he became Director of the Project, where he has full management responsibilities and oversees the management consultant, the joint venture of Bechtel/Parsons Brinckerhoff. In this role, he is also key liaison to MHD and EOTC, and is the primary Project spokesperson to the general public and media. Mr. Zuk is a graduate of Colgate University and Boston College Law School.

William Flynn

Deputy Project Director, Artery/Tunnel Project

General Flynn joined the Project in May 1992. A 35-year Army veteran, he most recently served as Commanding General, 21st Army Area Command, the European Theater. As Deputy Project Manager, he oversees internal operations, including direct liaison with B/PB core management. General Flynn holds a Bachelor of Science degree in Business Administration from Providence College and a Master of Science degree in International Relations from George Washington University.

Michael P. Lewis

Project Manager, Charles River Crossing DSEIS/R

Mr. Lewis was the MHD manager for the Charles River Crossing DSEIS/R. He was responsible for implementing Executive Office of Transportation and Construction policy direction relating to the design for the crossing, and to the DSEIS/R. He coordinated B/PB project management for the DSEIS/R, key editors, and was the primary liaison to special interest/citizens groups. Mr. Lewis has 9 years of design engineering experience with the MHD's District One Office. He attended McGill University, Montreal, Canada, and holds a Bachelor of Science degree in Civil Engineering from the University of Vermont.

Paul A. Stakutis

Manager of Environmental Planning, Artery/Tunnel Project

Mr. Stakutis is responsible for environmental matters associated with the planning, design, and construction of the Project. He has 16 years of environmental law and project management experience for major engineering and construction firms. He holds a Bachelor of Science degree from Boston College and a Juris Doctor degree from Suffolk University Law School, Boston.

Robert M. Ruzzo

Senior Counsel, Environmental

Mr. Ruzzo was responsible for the legal review of the Charles River Crossing DSEIS/R. He also is the Project's legal representative on the Central Artery Environmental Oversight Committee. He also headed the MHD team that reviewed DSEIS/R materials, closely working with B/PB editors of the document. Mr. Ruzzo holds a Bachelor of Arts degree from Colby College in Waterville, Maine, and a Juris Doctor degree from Georgetown University Law Center.

Gloria A. Fry

Counsel

Ms. Fry reviewed DSEIS/R sections on water resources, materials disposal, and hazardous waste. She has 22 years experience in Massachusetts government, materials disposal, water pollution control, overall environmental protection, and hazardous waste cleanup. Ms. Fry has served as Senior Deputy General Counsel with the Massachusetts Department of Environmental Protection. She holds an A.B. degree in Biology from Vermont College and a Juris Doctor degree from Suffolk University Law School, Boston.

Martin A. Nee

Manager of Mitigation and Community Affairs

Mr. Nee implemented the community relations plan for the Area North of Causeway Street subarea. Prior to joining MHD, Mr. Nee was chief of staff for a Representative to the Massachusetts Legislature, responsible for managing community affairs. He has 10 years of experience in community affairs in Boston. He received a Bachelor of Arts degree in Political Science from Boston College.

BECHTEL/PARSONS BRINCKERHOFF, MANAGEMENT CONSULTANT**Theodore G. Weigle, Jr.**

Project Executive

Mr. Weigle, a Vice President of Bechtel Corporation, oversees the design, construction, and environmental activities for the Artery/Tunnel Project, a joint venture of Bechtel and Parsons Brinckerhoff. He has served as the Executive Director of the Chicago Regional Transportation Authority and as Deputy General Manager for the Washington Metropolitan Area Transit Authority. He holds a Bachelor of Science degree from the State University of New York at Cortland and completed the Advanced Management Program at Harvard University's Graduate School of Business.

Sallye E. Perrin, P.E.

Deputy Project Manager

Ms. Perrin, as Environmental Core Manager, had overall responsibility for this DSEIS/R. She has over 16 years of experience in engineering and planning, including environmental compliance coordination and documentation for major transportation projects, environmental impact analyses, transportation alternatives analyses, land use planning, and public participation program development. Ms. Perrin received a Bachelor of Science degree in Environmental Sciences and a Master of Science degree in Civil Engineering, both from the University of Virginia.

Edward W. Ionata

Environmental Services Manager

Mr. Ionata provided direction and review for this DSEIS/R. He has 11 years of experience in environmental analysis and management for major infrastructure construction projects, including interdisciplinary environmental planning, permitting, and compliance. Most recently he was with the Massachusetts Water Resources Authority where he managed construction related environmental permitting. Mr. Ionata holds a Bachelor of Science degree in Natural Resources from the University of Rhode Island and a Master of Forest Science from Yale University School of Forestry.

Jeff J. Brunetti, P.E.
Manager, Preliminary Engineering

Mr. Brunetti was the primary liaison between the management consultant and MHD for this DSEIS/R, and particularly for the alternative designs presented in this document. He has 15 years of experience in the design and management of national and international transportation projects. Mr. Brunetti has a Bachelor of Science degree in Engineering from the University of Colorado at Boulder with a concentration in Structural Engineering.

Allan A. Hodges, AICP
Manager of Environmental Documentation

Mr. Hodges managed the preparation of the DSEIS/R and was responsible for its compliance with applicable EIS/R regulations, and for consistency with commitments made by MHD and FHWA in the 1991 FSEIS/R. He contributed several sections of the DSEIS/R text, and managed its overall preparation and the editorial review process. Mr. Hodges also was Editor-in-Chief for the 1992 Notice of Project Change (NPC) for the Revised Charles River Crossing, the 1991 Projectwide FSEIS/R, and principal author of the 1990 South Boston Haul Road SEIS/R. Mr. Hodges has over 27 years experience in project management and environmental impact report preparation and permitting for transportation, water resources, and development projects. He holds a Bachelor of Science degree in Community Development from Southern Illinois University and a Masters degree in Urban Planning from Michigan State University.

James A. Vears
Manager, I-93 Engineering

Mr. Vears, a professional civil engineer, manages design and engineering for the I-93 section of the Central Artery/Tunnel Project. He provided quality control review and managed preparation of design development for the Charles River crossing DSEIS/R. He holds a Bachelor of Science degree in Civil Engineering.

Richard A. Azzalina
Senior Civil Engineer

Mr. Azzalina was responsible for the development of conceptual and preliminary civil highway alignments for the I-93 segment of the Project from Kneeland Street to its northern limits. He developed more than 75 design options for the Charles River crossing during the past 6 years, and provided technical support to the Bridge Design Review Committee for 2 years. Mr. Azzalina also provided technical support, including engineering drawings, in the development of the 1991 FSEIS/R, the 1992 BDRC recommendation to the Secretary of Transportation, and the 1992 NPC. In addition, Mr. Azzalina conducted a technical review of Chapter 2 for this document and provided engineering drawings for all four designs. Mr. Azzalina has nearly 20 years of experience, with specific focus in highway design. Mr. Azzalina holds a Bachelor of Science degree in Civil Engineering from Northeastern University.

Christopher Barnett P.E.

Material Disposal Supervisor, Project Engineering

Mr. Barnett wrote the hazardous material section of this report. He has 9 years of experience in environmental/regulatory policy; as a technical manager for the MWRA and as a general engineer in the field of mechanical/metal fabrication. Mr. Barnett holds a B.S. degree in Mechanical Engineering and a Master of Science in Technology and Policy from MIT.

Chetlur G. Balachandran, Ph.D.

Noise and Vibration Specialist

Dr. Balachandran wrote the section on noise and vibration for the DSEIS/R. He has 33 years experience in acoustics, noise, and vibration on highway, transit, and railroad projects and in architectural and engineering noise control in the United Kingdom, New Zealand, Canada, and the United States. Dr. Balachandran received his Bachelor of Arts, Master of Science, and Ph.D. degrees in Acoustics from Madras University, India.

Beth A. Bower

Manager, External Affairs

Ms. Bower, an archaeologist, provided technical reviews of sections on historic resources and archaeology for the DSEIS/R. Ms. Bower has 18 years experience in archaeology and holds a Master of Science degree in Anthropology from Brown University.

James P. Carmody, P.E.

Senior Traffic Engineer

Mr. Carmody managed preparation of the technical traffic analysis and developed the traffic impacts from the construction staging for this report. He has 20 years experience in traffic engineering and transportation planning, and holds a B.S. in Civil Engineering and a Master of Science in Transportation Planning and Engineering from the Polytechnic Institute of Brooklyn.

Brenda Corbett

Senior Technical Writer/Editor

Ms. Corbett provided technical writing, editing, and proofreading for the DSEIS/R, and prepared the Glossary. She worked in a similar capacity in the preparation of the 1991 FSEIS/R for the Central Artery/Tunnel Project, the 1990 South Boston Haul Road SEIS/R, and other technical support documents for the Project. She has over 12 years experience in engineering and general business writing, and holds a Bachelor of Arts degree from Boston University.

Jonathan Crowley
Assistant Agency Liaison

Mr. Crowley was responsible for preparing the agency distribution list for the DSEIS/R and for the coordination and scheduling of meetings among appropriate agencies during the environmental review process. He assists in the administration of the Project cooperating agency program. He has a Bachelor of Arts degree in History from Salem State College.

John Cusack Jr., P.E.
Senior Utilities Engineer

Mr. Cusack was responsible for evaluating alternatives for the relocation of existing utilities for this DSEIS/R. He has 20 years of experience as a civil engineer, with his main area of expertise in water and sewer infrastructure systems. Mr. Cusack holds a Bachelor of Science degree in Civil Engineering from Tufts University and a Master of Sanitary Engineering from Pennsylvania State University.

Christina A. Dutch
Highway Engineer Trainee, FHWA

Ms. Dutch was involved in the review process for the DSEIS/R and drafted the Comments and Coordination section. Ms. Dutch previously worked in FHWA's Office of Environment and Planning. She holds a Bachelor of Science in Civil/ Environmental Engineering from Clarkson University in New York.

Melissa M. Laube, AICP
Senior Transportation Planner

Ms. Laube was the manager for the transportation chapter of this report. She has 15 years of experience in transportation systems analysis and planning. She received a Bachelor of Arts degree from Cornell University and a Master of City and Regional Planning from Harvard University's Graduate School of Design.

Katina Leodas
Community Relations Manager

Ms. Leodas prepared the community coordination section of the DSEIS/R and provided assistance in the quality control review of the document. She directs community relations for the Project and advises MHD on communicating and negotiating with residents and business owners in the affected communities. She holds a Bachelor of Science degree from Columbia University and a Juris Doctor degree from Harvard Law School.

Nancy Masison
Assistant Environmental Documentation Manager

Ms. Masison was responsible for review and editing of the right-of-way and other sections of this report. Before joining the Environmental Documentation Group, Ms. Masison worked previously on real property acquisitions in the right-of-way lands management department of the Project. Ms. Masison holds a Juris Doctor degree and a Certificate in Environmental and Natural Resources Law from Lewis and Clark Law School, Portland Oregon.

Curtis C. Meininger
Senior Environmental Scientist

Mr. Meininger prepared the fisheries section of the DSEIS/R. He has 12 years of experience in aquatic resource analysis and remedial studies, including participation in the preparation of the 1991 FSEIS/R. He has a Bachelor of Science and Master of Science degrees in Biology from the University of Cincinnati.

Jeffrey M. Paul
Permit Supervisor

Mr. Paul reviewed drafts of the DSEIS/R for quality control as he did previously for the 1992 Notice of Project Change for the Revised Charles River crossing. He is responsible for managing the preparation, filing, obtaining, and monitoring all environmental permits, licenses, and approvals for the Project. Mr. Paul previously managed the preparation of materials disposal, wetlands and waterways, vegetation and wildlife, Section 404 (b)(1) analysis for water quality, and floodplain chapters for the 1991 FSEIS/R for the Project. Over the past 20 years, Mr. Paul has managed the environmental portions of major public infrastructure projects. He holds a Bachelor of Arts degree from Colby College and a Master of Arts degree in Urban, Social, and Environmental Policy from Tufts University.

Benjamin G. Perez, AICP
Planner

Mr. Perez prepared the energy impact analyses for the DSEIS/R and for the Projectwide 1991 FSEIS/R. He has a Bachelor of Arts degree from Amherst College and a Master of Science degree in Urban Planning from Columbia University.

Stacy A. Richards
Agency Liaison Coordinator

Ms. Richards wrote the Agency Coordination section of the DSEIS/R, contributed to several quality control reviews of report text, and was responsible for regulatory filings and distribution of the document. Since 1988 she has managed the cooperating agency program under the National Environmental Policy Act for the Project. The program involves issue identification and resolution of 30 Federal, regional, State, and local agencies and their divisions during the environmental review process. Ms. Richards has 15 years of Federal, legislative, and regulatory experience. She holds a Bachelor of Arts degree in Political Science from Bucknell University, and a Master of Public Administration from Harvard University's Kennedy School of Government.

Guido Schattaneck
Senior Environmental Engineer

Mr. Schattaneck is the lead air quality analyst for the Project. He has prepared the air quality section of the 1992 NPC and the air quality mobile source analyses for the 1991 FSEIS/R and the 1990 South Boston Haul Road SEIS/R. He also is the principal author of one of the EPA's guideline models for air quality, and is a national appointee to the Transportation Research Board's committee on transportation and air quality. Mr. Schattaneck has over 15 years of experience in engineering and environmental modeling. Mr. Schattaneck received his Bachelor of Science degree and Master of Engineering in Electrical Engineering from the National Technical University of Buenos Aires, Argentina, and a Master of Engineering degree in Environmental Engineering from Manhattan College, New York.

Michael T. Smither, P.E.
Senior Civil Engineer

Mr. Smither was responsible for designing the alternatives to the 1991 FSEIS/R Proposed Action analyzed in the DSEIS/R, and compared the effects of design alternatives. In addition, he evaluated realignment schemes meeting the requirements of the client and participated in making recommendations for revisions to the Proposed Action. Mr. Smither has 28 years experience in civil and transportation engineering. He has a B.S. degree in Civil Engineering from the Virginia Military Institute.

John Stavola, P.E.
Construction Planning Engineer

Mr. Stavola was responsible for writing the section on construction planning and developed the construction staging for the DSEIS/R. He has 16 years of experience in design and construction of highway bridges. Mr. Stavola holds a Bachelor of Science degree in Civil Engineering from the University of Connecticut.

Ping K. Wan
Air Quality Specialist

Ms. Wan prepared the air quality impact sections related to ventilation building emissions of the DSEIS/R. She is an environmental scientist responsible for addressing and resolving air quality issues during the Project planning, design, and construction phases. Her duties also include conducting and performing air quality impact analysis involving both analytical and physical modeling, air quality field monitoring and environmental impact studies. Ms. Wan has 25 years of national and international experience in the field of meteorology and air quality. She holds a Bachelor of Science degree in Physics from the Chinese University of Hong Kong, a Master of Science degree in Natural Science from Pacific Lutheran University, and a Master of Science degree in Physics from Montana State University.

GRAPHICS AND REPORT PRODUCTION

Kathe Gregory

Supervisor, Graphics Department

Ms. Gregory supervised the preparation of all the graphics in this DSEIS/R and the 1992 NPC. She has had 14 years of experience as an art director, graphic designer and art instructor. She has a Bachelor of Fine Arts degree from Carnegie-Mellon University and a Master of Fine Arts from Rutgers University.

Kathleen Hepburn

DSEIS/R Graphics Coordinator

Ms. Hepburn coordinated the production of all graphics for the DSEIS/R. She has seven years of experience as a technical illustrator and computer consultant. Ms. Hepburn studied mathematics at the University of Colorado, and computer science and graphic production at Northeastern University.

Kathy Bates

Computer Graphics Specialist

Ms. Bates worked on all phases of graphics on the DSEIS/R. Ms. Bates received a Bachelor of Arts degree in Psychology from the College of the Holy Cross, a Graphic Design Certificate from Massachusetts College of Art, and a Certificate in Advertising from Northeastern University.

Kevin Abbott

Computer Graphics Specialist

Mr. Abbott is a designer specializing in computer graphics. He assisted in setting up the new Macintosh Computer System which was brought in specifically for the DSEIS/R. He created maps for the highway alternatives as well as for the pedestrian pathways and traffic movements. Mr. Abbott currently is pursuing his Master of Fine Arts degree at Brandeis University.

TEXT PRODUCTION

Paul E. Orr

Text Production

Mr. Orr was responsible for coordination of all text production for the DSEIS/R and auxiliary documents. He has several years of experience in both the publishing and computer fields, and has a Bachelor of Science degree in Anthropology from Hunter College, City University of New York.

Gina Park

Administrative Assistant, Environmental Services

Ms. Park produced the List of Preparers section of the DSEIS/R. She has 6 years of administrative experience in the environmental, real estate, and legal fields. Ms. Park holds a B.S. degree in Cartography from Salem State College with a concentration in Urban Economics, and a certificate in Paralegal Studies.

Marilyn Rowland, AICP

Senior Planner/Editor

Ms. Rowland has had numerous editing and writing responsibilities for the 1991 FSEIS/R including preparation of the summary and index for this DSEIS/R. She has 15 years of experience in urban planning, environmental impact analysis, and technical report editing. She has a Master of City Planning degree from Memphis State University.

THE BSC GROUP, INC.**Rebecca Longley**

Assistant Manager, DSEIS/R

Ms. Longley was responsible for coordination of the chapter authors and technical support for the preparation of the DSEIS/R, providing liaison with Graphics and other departments. She initiated the preparation of the early drafts of chapters on the purpose and need for action, alternatives, and affected environment. She was the principal author on the chapters concerning relationship of local short-term uses versus long-term productivity and irreversible and irretrievable commitment of resources. Ms. Longley has over 18 years of experience in environmental permitting and planning, including project management of large highway development projects. Ms. Longley received a Bachelor of Arts in Biology from Nason College in Springvale, Maine.

Burt Bryan, Ph.D.

Senior Biologist

Dr. Bryan is the NPDES coordinator for Project construction. He prepared the application for the NPDES permit for discharges of groundwater and stormwater resulting from construction, and prepares reports monitoring results obtained under this permit to the appropriate agencies. He also evaluates the Project's wetlands, water quality, and fisheries impacts. Dr. Bryan holds a Bachelor of Science degree and a Master of Science degree in Biology from the University of Vermont, and a Ph.D. in Marine Science from the University of Virginia.

Joseph Freeman
Senior Permitting specialist

Mr. Freeman was responsible for the preparation of the materials disposal section of the DSEIS/R. He previously served as an Associate Environmentalist with the MEPA Unit of the Massachusetts Executive Office of Environmental Affairs. He has 12 years of public and private sector experience in environmental impact assessment. He has a Master of Arts degree in Environmental Policy from Tufts University.

Alan Randall
Senior Environmental Engineer

Mr. Randall prepared the water quality section of the DSEIS/R and the Section 404 (b)(1) Appendix. He has 23 years of experience in environmental permitting, including 17 years with the U.S. Army Corps of Engineers. He received a Bachelor of Science degree in Civil Engineering from Worcester Polytechnical Institute.

Joanne Skaliotis
Environmental Scheduler

Ms. Skaliotis was instrumental in tracking the preparation of the chapters of the SEIS/R. Ms. Skaliotis has over 15 years in project controls, planning and scheduling. Ms. Skaliotis holds a B.S. in Civil Engineering Technology from the University of Massachusetts.

FORT POINT ASSOCIATES

Susan St. Pierre
Environmental Planner

Ms. St. Pierre was manager for the wetlands and waterways section of the DSEIS/R. She has 15 years of experience in municipal planning and environmental planning and permitting with the last 5 years focusing on waterfront issues. Ms. St. Pierre has a Bachelor of Science degree in Geography, with specialization in the environment, from Salem State College, and a Master of Arts in Geography, Community, and Regional Planning from Western Illinois University.

WALLACE, FLOYD, ASSOCIATES, INC.

James Purdy
Mitigation Planner

Mr. Purdy coordinated the Section 4(f) Evaluation and wrote the Parklands section of the DSEIS/R. He performed similar roles in the 1985 FEIS/R, the 1991 FSEIS/R, and the 1992 NPC. Mr. Purdy has worked on several transportation related plans and environmental impact documents for the past 16 years while with Wallace, Floyd, Associates, Inc. He holds a Master of City Planning degree from Massachusetts Institute of Technology.

Carole Schlessinger
Mitigation Planner

Ms. Schlessinger was responsible for the land use impacts section of the DSEIS/R. She has 13 years of experience in urban planning, and has been involved in land use and mitigation planning for the Project for 11 years. Ms. Schlessinger holds a Bachelor of Arts in Urban Affairs from Northwestern University and a Masters degree in Community and Regional Planning from the University of Texas at Austin.

Wendy Frontiero
Architect and Preservation Planner

Ms. Frontiero, a registered architect in Massachusetts, prepared the historic resources sections of the DSEIS/R, including the Section 4(f) Evaluation. She has a Bachelor of Arts degree from the University of North Carolina at Chapel Hill, a Master of Arts degree in Preservation Studies from Boston University, and a Master of Architecture from the Massachusetts Institute of Technology.

CAMBRIDGE SYSTEMATICS, INC.

Roanne Neuwirth
Assistant Economic Analysis Manager

Ms. Neuwirth assisted in preparation of the economic impact analysis in the DSEIS/R and 1991 FSEIS/R for the Project. She has worked on a wide range of economic development studies, transit and highway impacts studies, and real estate development. Ms. Neuwirth holds a Master in City Planning from Massachusetts Institute of Technology.

BOELTER & ASSOCIATES, INC.

Alice Boelter, Principal

Ms. Boelter prepared the navigation section of the DSEIS/R. She has 17 years of experience, including harbor and water transportation issues at Massport. She has a Bachelor of Arts degree in Political Science from Wellesley College and a Master of Arts degree in Public Policy from the University of Michigan.

Donna V. Rosasco
Senior Permitting Specialist

Ms. Rosasco has been involved in permitting for the Artery/Tunnel Project since 1990. She assisted in the preparation of the DSEIS/R and 1991 FSEIR/S sections relating to navigation. She holds a Bachelor of Science degree in Environmental Studies from the University of Massachusetts at Amherst, and a Certificate in Landscape Design from the Radcliffe program in Landscape Architecture.

TIMELINES, INC.

Elena Decima

Vice President/Archaeology

Ms. Decima was the principal archaeological investigator in the extended portion of the Area North of Causeway Street, and prepared the archaeological section of the DSEIS/R. Over a 9-year period, she has served as Field Archaeologist on numerous prehistoric and historic sites. For Timelines, Inc., she has supervised the excavation and analysis of the Boylston Street Fish Weir and has overseen field analysis and report writing on several of historic and prehistoric archaeological sites. In addition, she is an archaeologist a.b.d. in the doctoral program of the University of Pittsburgh.

STULL & LEE

Christopher Procter

Urban Designer

Mr. Procter was responsible for urban design components of the Charles River Crossing. He prepared the DSEIS/R sections on joint development and visual impacts. He has 9 years experience as an Architect and Urban Designer in practice and teaching, for public, private, institutional, and corporate clients, in Australia, New Zealand, and the United States. Mr. Procter holds a Bachelor of Architecture degree from the South Australian Institute of Technology, and a Masters of Architecture in Urban Planning and Design from Harvard University.

7. List of Agencies, Organizations, And Persons To Whom
Copies Of The Statement/Report Were Sent

Chapter 7

LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM THE DSEIS/R WAS SENT

The following Federal, State, regional, and local agencies, elected public officials, and other parties were sent copies of this DSEIS/R.

7.1 Agencies

Federal Agencies:

- Advisory Council on Historic Preservation
- Center for Disease Control
- Department of Commerce
 - National Marine Fisheries Service
 - National Oceanic and Atmospheric Administration
- Department of Defense
 - Army Corps of Engineers
 - Environment and Safety Office
- Department of Energy
 - Division of NEPA Affairs
- Department of Housing and Urban Development
- Department of Interior
 - Fish and Wildlife Service
 - Geological Survey
 - National Park Service
- Department of Transportation
 - Federal Aviation Administration
 - Federal Railroad Administration
 - Federal Transit Administration
- Coast Guard
- Environmental Protection Agency
- Federal Emergency Management Agency
- Federal Energy Regulatory Commission
- General Services Administration

Regional Agencies:

- Merrimack Valley Planning Council
- Metropolitan Area Planning Council
- Old Colony Planning Council
- South East Regional Planning and Economic Development District

State Agencies:

- Office of the Governor, Commonwealth of Massachusetts
- Department of Highways and Maintenance
- Executive Office of Administration and Finance
 - Division of Capital Planning and Operations

Executive Office of Communities and Development
Executive Office of Consumer Affairs and Business Regulation
Executive Office of Economic Affairs
 Office of Business Development
 Office of Training and Employment Policy
 State Office of Minority and Women Business Assistance
Executive Office of Environmental Affairs
 Coastal Zone Management Office
 Department of Environmental Management
 Department of Environmental Protection
 Department of Fisheries, Wildlife and Environmental Enforcement
 Division of Marine Fisheries
 Division of Resource Conservation
 Massachusetts Environmental Policy Act Unit
 Metropolitan District Commission
Executive Office of Health and Human Services
 Department of Social Services
Executive Office of Public Safety
Executive Office of Transportation and Construction
 Central Transportation Planning Staff
 Massachusetts Aeronautics Commission
 Massachusetts Bay Transportation Authority
 Massachusetts Port Authority
 Massachusetts Turnpike Authority
Massachusetts Water Resources Authority
Massachusetts Historical Commission
Office of the Inspector General
Office of the State Auditor, Budget Director

Other States/Agencies:

City of Honolulu, Hawaii
Maine Department of Transportation
New Jersey Department of Transportation
New York Department of Transportation

Local Agencies:

Office of the Mayor, City of Boston
Boston Business and Cultural Development Office
Boston City Clerk
Boston Economic Development and Industrial Corporation
 Office of Jobs and Community Services
Boston Emergency Medical Services
Boston Environment Department
 Boston Conservation Commission
 Boston Landmarks Commission
Boston Fire Department
Boston Harbormaster
Boston Health and Hospitals Department

Boston Housing Authority
 Boston Inspectional Services Department
 Boston National Historic Park
 Boston Office of Neighborhood Services
 Boston Parks and Recreation Department
 Boston Police Department
 Boston Public Facilities Department
 Division of Capital Planning
 Boston Public Works Department
 Boston Real Property Department
 Boston Redevelopment Authority
 Boston Director of Rodent Control
 Boston Transportation Department
 Boston Water and Sewer Commission
 Office of the Mayor, City of Cambridge
 Cambridge Environmental Program
 Cambridge Community Development Department
 Cambridge Public Works Department
 Cambridge Conservation Commission
 Office of the Mayor, City of Salem
 Office of the Mayor, City of Somerville
 Somerville Engineering Department
 Somerville Fire Department
 Fire Prevention Office
 Somerville Highway Department
 Somerville Inspectional Services Department
 Somerville Lights and Lines Department
 Somerville Planning and Community Development Department
 Somerville Planning Board
 Somerville Police Department
 Somerville Public Works Department
 Somerville Traffic and Parking Department
 Somerville Water Department
 Suffolk County Sheriff's Department

7.2 Elected Public Officials

Federal Legislators:

U.S. Senator Edward M. Kennedy
 U.S. Senator John F. Kerry
 U.S. Representative Peter I. Blute, 3rd District, Massachusetts
 U.S. Representative Barney Frank, 4th District, Massachusetts
 U.S. Representative Joseph P. Kennedy II, 8th District, Massachusetts
 U.S. Representative Edward J. Markey, 7th District, Massachusetts
 U.S. Representative Martin T. Meehan, 5th District, Massachusetts
 U.S. Representative J. Joseph Moakley, 9th District, Massachusetts
 U.S. Representative Richard Neal, 2nd District, Massachusetts
 U.S. Representative John W. Olver, 1st District, Massachusetts
 U.S. Representative Gerry E. Studds, 10th District, Massachusetts

State Legislators:

Senate:

Amorello, Matthew (Grafton)
Antonioni, Robert A. (Leominster)
Barrett, Michael J. (Cambridge)
Berry, Frederick E. (Peabody)
Bertonazzi, Louis P. (Milford)
Birmingham, Thomas F. (Chelsea)
Boverini, Walter J. (Lynn)
Buell, Robert C. (Boxford)
Bulger, William M. (Boston)
Chase, Arthur E. (Worcester)
Creedon, Micheal (Brockton)
Durand, Robert (Marlboro)
Havern, Robert A. III (Arlington)
Hicks, Lucille (Wayland)
Jacques, Cheryl A. (Needham)
Jajuga, James (Methuen)
Keating, William R. (Sharon)
Leahy, Daniel P. (Lowell)
Lees, Brian P. (Easthampton)
Magnani, David P. (Framingham)

McDonald, Brian J. (Weymouth)
Melconian, Linda J. (Springfield)
Montigny, Mark C. (New Bedford)
Morrissey, Michael W. (Quincy)
Murray, Therese (Plymouth)
Norton, Thomas C. (Fall River)
O'Brien, Shannon P. (Easthampton)
O'Brien, John D., Jr. (Andover)
Pacheco, Marc R. (Taunton)
Pines, Lois G. (Newton)
Rauschenbach, Henri (Brewster)
Rosenberg, Stanley C. (Amherst)
Shannon, Charles E. (Winchester)
Swift, Jane Maria (Pittsfield)
Tisei, Richard (Wakefield)
Travaglini, Robert E. (Boston)
Walsh, Marian (Boston)
Wetmore, Robert D. (Barre)
White, W. Paul (Boston)
Wilkerson, Dianne (Boston)

House of Representatives:

Angelo, Steven (Saugus)
Barsom, Valerie (Wilbraham)
Bellotti, Michael G. (Quincy)
Binienda, John J. (Worcester)
Blanchette, Kevin P. (Lawrence)
Bosley, Daniel E. (N. Adams)
Brenton, Marianne (Burlington)
Brett, James T. (Dorchester)
Brewer, Stephen M. (Barre)
Broadhurst, Arthur J. (Methuen)
Buell, Carmen D. (Greenfield)
Businger, John A. (Brookline)
Cabral, Antonio F.D. (New Bedford)
Cahill, Michael P. (Beverly)
Cahir, Thomas S. (Bourne)
Canavan, Christine E. (Brockton)
Caron, Paul E. (Springfield)
Casey, Paul C. (Winchester)
Cass, William (Wakefield)
Chesky, Evelyn G. (Holyoke)
Ciampa, Vincent (Somerville)
Clancy, Edward, Jr. (Lynn)
Clark, Forrester A. Jr. (Hamilton)

Cleven, Carol C. (Chelmsford)
Cohen, David B. (Newton)
Connolly, Edward G. (Everett)
Constantino, William, Jr. (Clinton)
Coon, Gary M. (Andover)
Correia, Robert (Fall River)
Cousins, Frank G., Jr. (Newburyport)
Cox, John F. (Lowell)
Decas, Charles N. (Wareham)
DeFilippi, Walter A. (W. Springfield)
DeLeo, Robert A. (Winthrop)
Dempsey, Brian S. (Haverhill)
DiMasi, Salvatore F. (Boston)
DiPaola, James V. (Malden)
Donovan, Carol (Woburn)
Doran, Stephen W. (Lexington)
Draisen, Marc D. (Boston)
Evans, Hasty (Wayland)
Fagan, James H. (Taunton)
Finneran, Thomas M. (Boston)
Fitzgerald, Kevin W. (Boston)
Flaherty, Charles F. (Cambridge)
Flavin, Nancy (Easthampton)

Forman, Peter (Plymouth)
 Fox, Gloria L. (Roxbury)
 Galvin, William C. (Boston)
 Gannon, Paul J. (South Boston)
 Gardner, Barbara (Holliston)
 Garrison, Althea (Boston)
 Gately, David F. (Waltham)
 Gauch, Ronald W. (Shrewsbury)
 Giglio, Anthony P. (Medford)
 Glodis, William J. Jr. (Worcester)
 Goguen, Emile (Fitchburg)
 Gray, Barbara E. (Framingham)
 Greene, William G. Jr. (Billerica)
 Haley, Paul (Weymouth)
 Hall, Geoffrey (Westford)
 Harkins, Lida (Needham)
 Hawke, Robert D. (Gardner)
 Hayward, Jeffrey J. (Lynn)
 Healy, Jonathan L. (Charlemont)
 Hermann, Joseph N. (Andover)
 Herren, Albert R. (Fall River)
 Hodgkins, Christopher J. (Lee)
 Honan, Kevin G. (Brighton)
 Hornblower, Augusta (Groton)
 Hyland, Barbara C. (Foxborough)
 Hynes, Frank M. (Marshfield)
 Jehlen, Patricia D. (Somerville)
 Jordan, Raymond A. (Springfield)
 Kafka, Louis L. (Sharon)
 Karol, Stephen J. (Attleboro)
 Kehoe, Marie-Louise (Dedham)
 Kelly, Shaun (Kelly)
 Kennedy, Thomas P. (Brockton)
 Kerans, Sally (Danvers)
 Klimm, John C. (Barnstable)
 Knapik, Michael (Westfield)
 Koczera, Robert (New Bedford)
 Kollios, Paul (Milbury)
 Kraus, Robert (Kingston)
 Krekorian, Robert (Reading)
 Lambert, Edward M. Jr. (Fall River)
 Landers, Patrick F. III (Palmer)
 Larkin, Peter J. (Pittsfield)
 Lawless, Robert C. (Orleans)
 LeLacheur, Edward A. (Lowell)
 Lewis, Jacqueline (Bridgewater)
 Madden, Peter E. (Weston)
 Mann, Charles W. (Hanson)
 Mannering, Vincent G. (Boston)
 Manning, Joseph M. (Milton)
 Mara, Francis G. (Brockton)
 Mariano, Ronald (Quincy)
 Marzilli, James J. (Arlington)
 McCarthy, Robert M. (Melrose)
 McDonough, John E. (Boston)
 McIntyre, Joseph B. (New Bedford)
 McManus, William J. II (Worcester)
 Menard, Joan M. (Somerset)
 Miceli, James R. (Willmington)
 Moore, Richard T. (Uxbridge)
 Murphy, Dennis M. (Springfield)
 Murray, Mary Jeanette (Cohasset)
 Nagle, William P. Jr. (Northampton)
 O'Brien, Janet W. (Hanover)
 O'Donnell, Karen (Waltham)
 O'Sullivan, Kevin (Worcester)
 Owens-Hicks, Shirley (Boston)
 Palumbo, Thomas G. (Newbury)
 Panagiotakos, Steven G. (Lowell)
 Parente, Marie J. (Milford)
 Paulson, Anne M. (Belmont)
 Pedone, Vincent A. (Worcester)
 Peters, David (Charlton)
 Peterson, Douglas, (Marblehead)
 Petrolati, Thomas M. (Ludlow)
 Platt, Marsha R. (Grafton)
 Poirier, Kevin (N. Attleboro)
 Quinn, John F. (Dartmouth)
 Ranieri, Daniel J. (Bellingham)
 Reinstein, William G. (Revere)
 Resor, Pamela (Acton)
 Rogeness, Mary S. (Longmeadow)
 Rogers, John H. (Norwood)
 Roosevelt, Mark (Boston)
 Ruane, Michael J. (Salem)
 Rushing, Byron (Boston)
 Scaccia, Angelo M. (Boston)
 Schur, Susan D. (Newton)
 Scibelli, Anthony M. (Springfield)
 Serra, Emanuel Gus (Boston)
 Simmons, Mary Jane (Leominster)
 Sprague, JoAnn (Walpole)
 Stefanini, John A. (Framingham)
 Stoddart, Douglas (Natick)
 Story, Ellen (Amherst)
 Straus, William M. (Mattapoisett)
 Sullivan, Michael J. (Abington)
 Sullivan, Joseph C. (Braintree)

Tarr, Bruce (Gloucester)
Teague, Edward B., III (Yarmouth)
Thompson, Alvin (Cambridge)
Tobin, Arthur Stephen (Quincy)
Tolman, Warren E. (Watertown)
Toomey, Timothy J., Jr. (Cambridge)
Tracy, Susan (Boston)
Travis, Philip (Rehoboth)
Turkington, Eric T. (Falmouth)
Valianti, Daniel (Marlboro)
Voke, Richard A. (Chelsea)
Wagner, Joseph F. (Chicopee)
Walrath, Patricia A. (Stow)
Walsh, Michael P. (Agawam)
Walsh, Thomas P. (Peabody)

7.3 Local Elected Public Officials

Boston City Councillors:

Menino, Thomas M., Acting Mayor of Boston
Bolling, Bruce
Byrne, James
Crayton, Anthony
Hennigan-Casey, Maura
Kelly, James
McLaughlin, Brian

Nucci, John
O'Neil, Albert
Salerno, Rosaria
Scondras, David
Travaglini, Robert
Yancey, Charles

Cambridge City Councillors:

Reeves, Kenneth, Mayor of Cambridge
Cyr, Edward, Vice Mayor of Cambridge
Duehay, Frank
Toomey, Timothy
Meyers, Jonathan

Russell, Sheila
Sullivan, Walter
Walsh, William
Wolf, Alice

Cambridge School Committee:

Davis, Henrietta
Fantini, Fred
Maher, David

Rafferty, James
Simmons, Denise
Weinstein, Larry

Somerville Aldermen:

Capuano, Michael E., Mayor of Somerville
Cappello, Maryann
Connolly, John

Joyce, Kenneth
O'Dea, Cathleen
Taylor, Thomas

7.4 Organizations

Municipalities:

Arlington, Town Manager	Melrose, Mayor
Belmont, Board of Selectmen	Milton, Selectmen, Chairman
Beverly, Mayor	Nahant, Board of Selectmen
Braintree, Administrator	Newton, Mayor
Brookline, Board of Selectmen	Peabody, Mayor
Danvers, Town Manager	Quincy, Mayor
Dedham, Executive Secretary	Stoneham, Community Devel. Coordinator
Gloucester, Mayor	Wakefield, Board of Selectmen
Lexington, Town Manager	Waltham, Mayor
Malden, Planning Director	Watertown, Town Manager
Manchester, Executive Secretary	Wellesley, Town Manager
Marblehead, Board of Selectmen	Wellfleet, Selectmen
Medford, Mayor	Woburn, Mayor

Libraries:

Boston Public Library
Main Library, 666 Boylston Street
Charlestown Branch, 179 Main Street
Document Receipts
East Boston, 276 Meridian Street
East Boston, Orient Heights, 18 Barnes Avenue
Fine Arts, P.O. Box 286, Boston
Government Documents Section, Copley Square, P.O. Box 286
Kirstein Business Branch, 20 City Hall Avenue
North End, 25 Parmenter Street
South Boston, 646 East Broadway
South End, 685 Tremont Street
West End, 151 Cambridge Street

Boston Redevelopment Authority Library, Boston City Hall, 9th Floor
Bostonian Society Library, Old State House, 206 Washington Street
Brookline Public Library, 361 Washington Street

Cambridge Public Library
Main Branch, 449 Broadway
Boudreau/Observatory Hill Branch, 245 Concord Avenue
Central Square Branch, 45 Pearl Street
Collins/Mt. Auburn Branch, 64 Aberdeen Avenue
Heritage Branch, 48 Sixth Street
North Cambridge Branch, 70 Rindge Avenue
Valente Branch, 826 Cambridge Street

Central Artery/Tunnel Project, One South Station, Boston
Chelsea Public Library, 569 Broadway
Concord Public Library, 129 Main Street
Dedham Public Library, 43 Church Street
Federal Highway Administration, 55 Broadway, 10th Floor, Cambridge

John F. Kennedy Library, Columbia Point
 John F. Kennedy Library & Museum
 Kennedy Library
 Malden Public Library, 36 Salem Street
 Medford Public Library, 111 High Street
 Melrose Public Library, 69 West Emerson Street
 Milton Public Library, 476 Canton Avenue
 Massachusetts Board of Library Commission, 648 Beacon Street, Boston
 Massachusetts Institute of Technology (M.I.T.), Barker Engineering Library, Cambridge
 M.I.T. Rotch Library
 M.I.T. Lab for Computer Science Library, 545 Technology Square
 Parlin Memorial Library, 410 Broadway, Everett
 Revere Public Library, 179 Beach Street
 Robbins Library, 700 Massachusetts Avenue, Arlington
 Sandwich Public Library, 142 Main Street, Sandwich
 Shute Memorial Library, 781 Broadway, Everett
 Somerville Public Library, 79 Highland Avenue
 South Dennis Public Library, 389 Main Street, South Dennis
 State House Library, State House, Boston
 State Library of Massachusetts, State House, Boston
 State Transportation Library, Transportation Building, 10 Park Plaza
 Stoneham Public Library, 431 Main Street
 Thomas Crane Public Library, 40 Washington Street, Quincy
 Toby Transportation Library, 10 Park Plaza
 University of Massachusetts Library, Amherst, MA
 Ventress Memorial Library, Library Plaza, Marshfield, MA
 Wellesley Free Library, Box 308, Wellesley
 Weymouth Public Library, 46 Broad Street
 Winthrop Public Library, 2 Metcalf Square

Businesses, Other Organizations, and Individuals:

1000 Friends of Massachusetts	American Lung Association of
7 Mile River Association	Massachusetts
A.D. Hilyer & Company	American Planning Association
A.H. Harris & Sons, Inc.	Amtrak, Real Estate Division
Abramo Fish Co. Limited Partnership	Anderson Associates
Abruzzio, Grace	Anderson Nichols, Inc.
Acentech, Inc.	Andrew Square Civic Association
AFCED-AEQ, Environmental Management	Antronics Inc.
Office, Ft. Devens	Architects Collaborative
Aiello, Joseph and Mary	Arinc Research
Airport Impact Relief (Air, Inc.)	Arrowstreet Inc., Associate
Allen & Company	Arthur D. Little
Allen, John S.	Aserkoff, Janet, Rappaport & Raykov
Allied Plywood	Asian-American Resource Workshop
American Automobile Association	Asian Community Development Corporation
American Consulting Engineers Council of	Associated General Contractor
New England	Associated Industries of Massachusetts

ATEX, Inc.	Boston Sand & Gravel Company
Atlantic Ave. Abutters Group	Boston Society of Landscape Architects
ATR Transport Associates of America	Boston Society of Architects
B.M. Plumbers Union Local 12	Boston Sun Transcript
B&B Oil Company, Rutherford Avenue	Boston Tea Party Ship & Museum
Babrouti, Sebouh	Boston Thermal Energy
Barker Steel Company	Boston Typographical Union No. 13
Barnes & Jarvis, Inc.	Boston Waterfront Neighborhood Association
Barre Conservation Commission	Boston Wharf Company
Barron, Edward R.	Boudreau, Perry M.
Bates Brothers Seam Face Granite Company	Bracken, Thomas
Bay State Financial Services	Bradley, Peggy and Jim
Bay State Steamship Company	Braman Dow and Company
Beacon Companies	Brennan, Gary
Beacon Hill Civic Association	Brennan, Judy
Beal Company	Bronner Slosberg Humphrey
Bechtel Group, Inc.	Brown, Gary
Bechtel Power	Brown Rudnick
Bennett Investment Properties	Bruce Campbell & Associates
Berger Associates	BSC Group
Bergmeyer Associates	Building Trades Council
Berman Company, The	Bunker Hill Community College
Bernard, Michael M.	Bunker Hill Tenants Task Force
Bewick, John	Buonomo, John
BGS Systems, Inc.	Burke, Steven R.
Bingham Dana Gould	Buts, Pamela
Birmingham Properties	Cabot Partners Limited Partnership
Bjorklund, Doris	Cafe Paradiso, Inc.
Blake, Phoebe	Cambridge Chamber of Commerce
Bluestone, Lawrence H.	Cambridge Citizens for Liveable Neighborhood
Bole, Robert W., III	Cambridge Community Develop. Dept.
Bolognese, Angela	Cambridge Hospital, Department of Medicine
Bond, Schoeneck & King	Cambridge Seven Associates
Boston Area Bicycle Coalition	Campbell, Robert
Boston Aviation Council	Capola, Joseph
Boston Business Journal	Carangelo, Ferdinand
Boston Chamber of Commerce	Cardoso, M. Teresa
Boston District Council of Carpenters	Cargill Masterman & Culbert
Boston Edison Company	Carr, Lynch, Hack & Sanderl
Boston Financial Group	Carter, David, Royal Commission
Boston Flower Exchange, Inc.	Casendino & Company
Boston Freight Terminals	Cashman, Jack
Boston Gas Company	Cashman Marine Enterprises
Boston Globe, Graphics Department	Cawley, John
Boston Greenspace Alliance	Cecere, Anthony
Boston Harbor Associates	Center for Environmental, Health & Injury
Boston Harbor Industrial Corporation	Century Engineering, Inc.
Boston League of Women Voters	Cerone, Carmine, Carpenter & Company
Boston Natural Areas Fund	
Boston Preservation Alliance	

Charles River Park Association
 Charles River Park Management
 Charles River Watershed Association
 Charles River Publishing, Inc.
 Charles T. Main
 Charlestown Business Association
 Charlestown District Court
 Charlestown Historical Society
 Charlestown Neighborhood Council
 Children's Museum
 Chin, Helen
 China Housing and Land Dev Task Force
 Chinese Consolidated Benevolent
 Association
 Chinese Economic Development Council
 Chinese Merchants Association
 Cho, Yee
 Choate, Hall & Stewart
 Christopher, Alice
 Cipriano, Anthony
 Citizens for a Livable Charlestown
 City of Calgary, Department of Corporate
 Research
 Clark, Jim
 Coastal Oil New England
 Coleman, Francis
 Commercial Union Insurance Company
 Communitas, Inc.
 Community Information Center
 Computer Museum
 Computower Corporation
 Conant, Donald R.
 Congress Group Ventures
 Congress Realty Company
 Conrail
 Conservation Law Foundation
 Consilvo, Francis T.
 Consolidated Rail Corporation, PA
 Consolidated Rail Corporation, NJ
 Constitution Marina
 Construction Industries of Massachusetts
 Consulting Engineers Group Inc.
 Conte, Frank
 Contos, Nicholas
 Conway Inc.
 Conway, Jim & Gloria
 Cope Associates
 Corbin, John
 Cornu Management
 Corp. Communications, World Trade Ctr.

Corporate Legal Service
 Corrigan, Helen
 Costa Food Service
 CRA
 Crafts, Jeffery
 Cruz-Burke, Diane
 CSI Resource Systems Inc.
 Cuddy, Lynch, Manzi & Bixby
 Cummings, Francis
 Cunha, Thomas & Marcia
 Cushman & Wakefield
 D.J.K. Associates
 D'Agostino, Edward
 Dana, Marshall
 Darling, Marilyn
 DATA
 David Dixon & Associates
 De Leuw, Cather & Company
 Debole, Paul
 DeCandia, Stephen L.
 Dechert, Price & Rhoades
 DeFeo, Jim
 DEH - Real Property
 DeLeuw, Cather & Company
 DePaulo, Sonny
 Design-Science International
 DeVeber, Peter & Jean C.
 DiLibero, Nick & Maria
 DiLorenzo, George
 DiPasquale, Julie Anne
 Division of Fisherman and Wild Life
 Dixon, Vince
 Doherty, Joseph
 Donaher, Cathy
 Donovan, Jim
 Dorchester Alliance Neighborhood Assoc.
 Doreen Hahn
 Dosch, Michael J.
 Downtown Crossing Association
 Downtown North Association
 Duhamel, Paul
 Dunderdale, Lena
 Eagle Hill Civic Association
 Earls, Michael
 East Boston Concerned Citizens Association
 East Boston Savings Bank
 East Boston Social Center, Golden Agers
 East Boston Veterans Council
 East Boston Courthouse
 East Boston Neighborhood Health Center

East Boston Community Development
 East Boston Area Planning Council
 Eastern Airlines
 Easthampton Town Hall
 Ebasco Services Incorporated
 EBT Associates
 Ecumenical Community Council
 Edwards & Kelcey Inc.
 EHA Architects
 Eight Streets Neighborhood Association
 Electronic Systems Association
 Ellis Neighborhood Association
 ELS Language School
 Elwood, John R.
 Emerson, Bob
 Energy Systems Inc.
 Engstrom, William
 ENSR Consulting & Engineering
 Environmental Citizen Organization
 Environmental Engineer
 Environmental Futures
 Environmental Lobby of Massachusetts
 Environmental Strategies
 Equipment & Systems for Industry, Inc.
 Equitable Real Estate
 Evans, Eric
 Fabich, Doris R.
 Factory Mutual Research Corporation
 Falcone, Joseph F.
 Fallon Hines & O'Connor Inc.
 Faneuil Hall Marketplace - General Manager
 Favaloro, Joseph, Jr.
 Favaloro, Sandra
 Favaloro, Stacey
 Fawcett, Betsy C.
 Fay, Spofford & Thorndike, Inc.
 Federal Express
 Federal Reserve Bank of Boston
 Feeney, Elizabeth M.
 Fermer, Jim, Jung, Brannen Assoc. Inc.
 Ferri, Mark
 Ferullo, William and Lucy
 Filoso, Andy
 Fincham Associates
 Fiore, Elsie
 Fishery Products
 Fitch, Wiley, Richlin & Tourse
 Flaherty, Michael
 Flatley Company, The
 Foley Eliot & Hoag

Fort Hill Square Phase II Association
 Fort Point Arts Community
 Fraggos, Charles
 Fraser, Jim
 Frazier, Clark
 Frechette, Al, Milan
 Freilich, Joel
 Friedman & Atherton
 Friends of Muddy River
 Friends of Post Office Square
 Friends of the Boston Harbor Islands
 Froio, John A.
 Frost, Andrew, Associated General
 Contractors
 Furrer, Jeannine K.
 Gage, William T.
 Gallagher, Phil
 Galvin, Bill
 Gardner, David
 Gay, Dorothy
 Georgia Tech, School of Civil Engineering
 Geotechnical Engineers, Inc.
 Geraigery, Nicholas
 Giffee, Phil
 Gifford, Pebble
 Gifford's Fine Foods
 Giller, Phyllis
 Gillette Company
 Ginsburg, Arnold
 Gioiosa, Josephine
 Giorgio, Ralph
 Gladstone, Carol
 Gnazzo, Jerold A., Trustee
 Goldberg, Zoino & Assoc., Inc.
 Goodwin, Proctor & Hoar
 Gore Street Citizens Committee
 Gorove Slade Association
 Goulston & Storrs
 Government of Ontario
 Gowell, Elizabeth
 Graham Gund Architects
 Graves Landing
 Gray, John R.
 Gray, Justin
 Great Meadows NWR
 Great Northern Industry
 Great Northern FND
 Grtr. Boston Chamber of Commerce
 Grtr. Boston Convent. & Visitors Bureau
 Greater Boston Community Development

Greenbaum, Mark, Graphic Arts
 Greene, C. F.
 Guilford Transportation Industries
 Gunther Engineering
 Gunwyn Company
 Gurel, Ozan
 H. N. Gorin Associates, Inc.
 Hagan, Tod, c/o Higgin
 Hale & Dorr
 Halfyard, Robert
 Hall, Debra
 Halvorson Company
 Hamlin, Collier, Thompson & Doyle
 Hammond, Joseph
 Hanson Engineers
 Hanson, Norman B., Saugus, Town of
 Harkins, Annette
 Hartman, Frederick
 Harvard Graduate School of Design
 Harvard School of Public Health, Dept. of
 Environmental Services
 Harvey, Paul
 Hatch Associates
 Haymarket Pushcart Association
 Heisey, Lynn
 Hill & Barlow
 Hines Interests
 Hinkle, Joseph
 Hislop, Gordon
 Historic Neighborhood Foundation
 HMM Associates, Inc.
 Hoffman, Fenno
 Hooper, Ann
 Hopkinson & Partners
 Horowitz, Stash
 Hotel Management & Development, Inc.
 House of Bianchi, Treasurer
 Howry, Jeff
 HP Hood Inc.
 Huang, Kuen Shen, Philadelphia, PA
 Hunneman Commercial
 Hunneman Real Estate
 HW Lochner, Inc.
 International Union of Oper. Engrs. L.U.
 #4, Roslindale, MA
 Israel Economic Office
 ITMA University Hospital
 Ives, Jerry
 J. F. White Contracting Company
 Jager, Smith, Stetler & Arunta

James Hook & Company
 Janedy, Nicholas
 Jeffries Point Neighborhood Center
 Jets Club
 JHK & Associates
 John Drew Company
 John M. Corcoran & Company
 John Reilly Association
 Johnson, Richard
 Jordan Marsh
 Jung/Brannen Associates Inc.
 K.E. Alexander & Associates
 Kaiser, Steve
 Karlson, Dan
 Karp, Allen
 Katz, Jane, c/o Michael Rosenfeld
 Kaufman Associates
 Kaufman, Jay R.
 Kehoe, Peter J.
 KEL Design
 Kelly, Anne, Red Bank, c/o Janet Young
 Kennedy, Violich Architects
 Kenney Development Company
 Keohine, Detoure & Keegan
 Kerr, Kevin
 Keyes, Nancy
 Kidston, Don
 Kittredge, Stanley M.
 Klibaras, D.
 Koff, Robert L., Steven J. Marullo, Esq.,
 Attorney at Law
 Kopelman & Paige, P.C.
 Koty, Stanley, Jr.
 Kovacevic, Dan
 Kramer, Bernard
 Kratzmann, Monika
 Kruger, Christopher
 Kuttner, Bill
 Kverik, Rosemary
 Labor District Council
 Lacerda, Fred, Sullivan Group
 LaMattina, Sal
 Lane & Altman
 Langone, Fred
 LaSalle Partners
 League of Women Voters - Waltham
 Leers, Weinzapfel Associates
 Leggat Company, The
 Lenz Engineering
 Leonardi, Ron

Liberty Bell Wholesale Grocery
 Life Focus Center
 Limbach Company
 Loathell, Thomas
 Loewenstein, Ernest
 Logue, Edward J.
 LoMans, Patricia
 Lombard, Matt
 Lombardo, Sal
 Lord, Bill
 Louis Berger & Associates, Inc.
 Loving, David
 Maass, Arthur
 MacIver, Donald
 Macomber Development Company
 Mader, Bernice
 Mahoney, Hawkes & Goldings
 Manning, Paul W.
 Maramaldi, Diane
 Marchi, Roberta
 Marchione, Nick
 Markis, Delphine
 Marvin, W. Barnes and Jarnis
 MASCO
 MassPirg
 Massachusetts Association of Conservation
 Commissions
 Massachusetts Audubon Society
 Massachusetts Bay Marine Studies
 Consortium (U Mass.)
 Massachusetts Business Roundtable
 Massachusetts Department of Industrial
 Accidents
 Massachusetts General Hospital
 Massachusetts Institute of Technology
 Massachusetts Institute of Technology-
 Graduate School of Architecture
 Massaro, Fred
 Masterman, Culbert & Tully
 Mastrangelo, Vito
 Mather, Edward
 Matsumiya, Pat
 Maverick Task Force
 Maynes, Kathryn
 McCaffrey, Jay
 McCarter Hoffman, Cheryl
 McCarthy, Elaine
 McClure, Peter
 McCourt Company
 McDonald, John, II

McDonnell Douglas
 McDonough, Kate
 McFarland Associates
 McGinley Hart Associates
 McGregor Shea & Doliner
 McHugh, Steve
 McKellar, Brian
 McKenna, Barry
 McKinnon, Anne
 Megna, Bobby
 Mercantile Wharf Association
 Meredith & Grew
 Merlino, Thomas
 Metro Toronto Roads & Traffic Department
 Metrowest Growth Management Committee
 Michigan State University - Barr Planning &
 Design Library
 Michigan State University
 Mieth, Carolyn
 Milczarek, Maria
 Miller, Gail
 Miller, Harvey S., Aleppo Shrine Yacht Club,
 Commodore
 Millian, Richard
 Mintz Levin Cohn Feffis
 Mitchell, J. Philip, Construction Industries
 of Massachusetts
 Modica, Diane
 Moody, Rhett
 Moore, William A.
 Morash, Evelyn
 Morgan, Michael
 MoveMass 2000
 Mucci-O'Shea, Marie
 Murphy, DeMarco & O'Neil, P.C.
 Muscat, Dan
 Museum of Science
 Museum Wharf
 N.O.A.H.
 Napoli Company, Inc.
 National Car Rental System Inc.
 National Relocation
 National Trade
 National Trust
 Neelon Companies
 Neff, Elish, Meredith & Grew, Broker
 New Boston Garden Corporation
 New England Legal Foundation
 New England Management Company
 New England Telephone Company

New England Aquarium
 No Name Restaurant Inc.
 Norfolk Central Labor Council
 North Area Task Force
 North Bennett Street School
 North End Nursing Home
 North End/Waterfront Council
 North Shore Chamber of Commerce
 North Suburban Chamber of Commerce
 Northeastern University - Department of
 Biology
 Northeastern University - Snell Library
 Northeastern University - History
 Department
 Northland Investment Company
 Northridge Development Company Inc.
 Noymer Manufacturing Company
 Nucci, John
 NYS Parks & Recreation Historic
 Preservation
 O.H. Community Center
 O'Brien, Marty
 O'Connell, Sandra
 O'Day Pavlo Engineering Company
 O'Neil, Shane
 Old North Church
 Old South Meeting House
 Olive's
 Ondras Company
 Order of the Sons of Italy
 Orient Heights Neighborhood Organization
 Orient Heights Improvement Organization
 Orlandi, Roland
 Our Lady of Mount Carmel
 Our Lady Airways Chapel, Logan Intl Airport
 Palladino, Elvira "Pixie"
 Palma, Sue
 Palmer & Dodge
 Palmer, Gregory
 Panorama Products
 Papesch & Associates
 Paris Street Gym
 Park Avenue Realty
 Parker, Coulter, Daley & White
 Parsons, Brinckerhoff, Quade & Douglas
 Patel, Ruth
 Patriot
 Paul Revere Memorial Association
 Payette Associates
 Peabody & Arnold

Peabody & Brown
 Peirce, AIA, John W.
 Peltier, Louis
 Perland Environmental Technologies
 Peter Cucchiara Trustee
 Peter, Elliot & Company
 Peter Roudebush & Associates
 Peterson, Nancy
 Philippi, Eric and Jane
 Piacenza, Norma
 Piccione, Matt
 Piers PAC
 Pinches, Fred
 Pollard, Daniel
 Poulos, George
 Preble, George
 Precast/Prestressed Concrete Institute
 Price, John
 Price, William
 Priest, Barry
 Prince, Keiko
 Pugliano, Emilie
 Putnam Investments
 Quincy School Community Council
 R.M. Bradley & Company, Inc.
 Rackemann, Sawyer & Brewster
 Raggio, Gabriel, Simultec
 Ramada Hotel
 Reason Foundation
 Relber, J.K.
 Reliable Bus Lines, Inc.
 RelMax Collaborative
 Riccioli, Joseph A., Local 82 (Teamsters)
 Richard Sugder Library
 Riseman, Jean
 Rizzo Associates, Inc.
 Roadway Express
 Robert E. Hannigan Associates
 Robie Properties
 Rose Associates, Inc.
 Rowan, Jim
 Rubin & Rudman
 Ruggerio, Mr. & Mrs.
 Russell & Scott
 Russo, Joseph F.
 Sacred Heart Church
 Salemme, Hugo
 Salvucci Association
 Sand, Michael
 Sanford Ecological

SAR Engineering Inc.	Stock Market Index
Sarno, Joseph	Stone & Webster Engineering
Sasaki Associates	Stone, Ken
Save the Harbor/Save the Bay	Stop & Shop Companies
Scialabba, Joyce	Stouffer, Caroline
Scopa, Bobby	Stouffer, James, Slade Gorton & Company
Shaeffer, K. H.	Stryker, Lois
Shah Associates, P.C.	Stubblebine Company
Shapiro, Eyal	Subaru of New England
Shapiro, Israel & Weiner	Sullivan and Worcester
Sheehan, J. Paul	Sullivan, D.F.
Sheinfeld, Peter	Sullivan Properties
Shell Station (Rutherford Ave.)	Superior Office Services
Shen, Milsom & Wilke	Surety Insurance
Sidney Fruman, et al	Sverdrup Corporation
Sierra Club of New England	Synergy Organization
Silans, Andy	Taiwan Area National Freeway Bureau
Skidmore, Owings & Merrill, Partner	Tammi, Jane
Slade Gorton Company	TAMS
Slep, Gary	Tauro, Benny
Smith, McNulty & Kearney	Tech Environmental, Inc.
Snow, Crocker	Teixeira, Maxine Tassinari
Snow, Roger L.	Testa, Eugene
So, Simon	Thideman, Karl
Society for the Preservation of New England Antiquities	Thomas Planning Services
Sokoloff, Martin	Thompsons Island Education Center
Solomon Parking	Tirrell, Lillian
Sommer, Mark	Tishman Construction Corporation,
Sonduck, Carol	Tobin, John
Sonesta International Hotels	Todd\Lea\Clark\Rozas Associates,
South Boston Residents Group	Tolman Manufacturing & Supply
South Boston Citizens Association	Tolman Mfg. and Supply
South Boston Neighborhood House	Tomas, John
South Boston Community Health Center	Toomey, William
South End Historical Society, Inc.	Trueman, Jeffrey, Faneuil Hall Marketplace
South End Transportation Committee	Trust for Public Land
South Shore Coalition	Trustees of Reservations
South Shore Chamber of Commerce	TSJ Management
Spaulding & Slye	Tufts University
Spaulding, Josiah A.	Turner, Ginny
Spaulding Rehabilitation Hospital	Tuttle, William
St. Cyr, Virginia	Two 40 Southampton Street, Inc.
St. John, Ivy	U.S. Department of Veterans Affairs
St. Vincent's Neighborhood Group	U.S. Postal Service, support Services, Boston Division
Standex International Corporation	UHB Inc.
Staropoli, Jean Denise	Univ. of Mass. Boston, Facilities Planning Office
Stefano, Fred	Univ. of Mass. Boston, Harbor Campus
Steffano, Joseph	University of Massachusetts Boston, Urban
Stillman, Mel	

Harbor Institute
Urbanimage Corporation
Valente, Carl, Needham, Selectmen's Office
Vanasse, Hangen, Brustlin
Vander Waker, Peter
Vazza Associates
Vetter, Henri
VHB
Victor Capital Group
Vitale, Christine, c/o Mary Vitale
Vogel, Raymond H., Jr.
Vollmer Associates
Vroom, Eileen
Vroom, Eric
VTN Northeast Inc.
Wakefield Concrete
Wang Industrial Laboratories, Inc.
Wardell, Joseph
WCH Industries Inc.
Wehran Engineering
Weil, Alan
Wentworth Institute of Technology
Weston & Sampson
Whelan, Jack & Ellen
White, Tom
Widett, Slater & Goldman, P.C.
Wilbur Smith Associates
William Rawn Associates
Williams College - Ctr. for Env. Studies
Winiger, Jim
Worcester O.P.C.D.
World Wide Package Association
XL DataComp
Yngvason, Haftor
Yuhas, William A.
Zarrilli, Vincent F.
Zenwa, Inc.
Zuccaro, John and Grace
Zupkus, John B.

8. Comments And Coordination

Chapter 8

COMMENTS AND COORDINATION

This section briefly describes the public involvement and public agency liaison activities associated with developing this DSEIS/R for the Charles River crossing portion of the Central Artery/Tunnel Project in the Area North of Causeway Street Project subarea.

In addition, at the end of this section are certain documents referred to in this report. They include the FHWA's Scope of Work for this DSEIS/R; the Certificate of the Secretary of Environmental Affairs on the 1992 NPC for the Revised Charles River Crossing, which also details the scope of this DSEIS/R; and the 1984 Memorandum of Agreement by the Section 106 agencies, MHD, and FHWA, regarding mitigation of impacts on historical and archaeological resources for the entire Central Artery/Tunnel Project.

8.1 PUBLIC INVOLVEMENT

Public meetings and open houses were held in Charlestown on October 29, 1992, in East Cambridge on November 5, 1992, at the Spaulding Rehabilitation Hospital on November 10, 1992, and at South Station on November 12, 1992, regarding the NPC for the Revised Charles River Crossing (i.e., Alternative 8.1D Mod 5). The Federal and State environmental review processes were explained at these meetings.

In response to requests following the receipt of both Federal and State scoping requirements for the preparation of the DSEIS/R, Project staff has regularly met with many of the concerned and affected parties in the Charles River crossing Project subarea. These include the following:

- The Artery Business Committee, including the Executive Committee and a number of subcommittees
- Boston Artery Focus Group, which is comprised of:
 - Downtown North Association
 - Beacon Hill Civic Association
 - Charles River Park
 - New Boston Garden Development Corporation
 - Massachusetts General Hospital
 - Massachusetts Eye and Ear Infirmary
 - Spaulding Rehabilitation Hospital
 - Museum of Science
- Central Artery Environmental Oversight Committee
- Massachusetts Department of Capital Planning and Operations
- City of Boston Transportation Department

The purpose of the meetings was to inform these groups about the status of the Revised Charles River Crossing, described in the 1992 NPC, to describe the features of the two new design alternatives in this DSEIS/R that are consistent with the NPC design, and to obtain input regarding the effects of the new design as well as possible design refinements to them. The environmental effects of design alternatives are evaluated throughout this DSEIS/R. Potential design refinements are discussed in Section 2.6.

Comments Received And Responses. Over 75 letters with more than 700 individual comments were received on the above referenced NPC. In addition, over 50 letters were received on the MHD's Notice

in the *Environmental Monitor* about USACE's request to consider an alternative with fewer impacts to waters of the United States.

The majority of these commenters requested the inclusion of a North Station-South Station rail connection as part of the Revised Charles River Crossing. FTA is currently examining the feasibility and demand for such a rail link. The FTA study will be monitored and evaluated throughout the environmental process and subsequent design phase of the highway project. Concurrently, the Commonwealth, through the Central Artery Rail Link Task Force, has evaluated a rail link alignment in the Central Artery corridor. Neither Scheme Z nor the three new design alternatives precludes construction of the rail link in the Area North of Causeway Street.

Other comment letters focused on reinstating the eastbound tunnel from Storrow Drive to I-93 under Leverett Circle, which had been considered by the Bridge Design Review Committee. The feasibility of improving the existing Leverett Circle design with and without the eastbound tunnel has been evaluated. Scheme Z, the Reduced River-Tunnel and the Non-River-Tunnel Alternatives include the eastbound tunnel, and are evaluated in the DSEIS/R.

The MBTA and others have expressed concern regarding the disruption of public transit service during construction, particularly the commuter railroad tracks behind North Station, Green Line and Orange Line service, and access to the new MBTA garage now under construction behind Boston Garden. This DSEIS/R describes how the Project will be built in the Area North of Causeway Street, and its interfaces with public transit and rail service.

Boston Water and Sewer Commission, Boston Thermal Energy Company, Boston Edison, and New England Telephone require the maintenance of their utility service during construction. The location of affected conduits, the design of relocations, and the construction and sequencing of relocation and easements for relocated facilities will be addressed in detail during preliminary and final design. Major affected utilities are identified in this DSEIS/R. Construction contracts in this area will adhere to the Project's Maintenance of Utilities Plan.

Questions were raised regarding the impacts of Ramp CL, I-93 northbound to Rutherford Avenue, through the Bunker Hill Community College athletic fields, and traffic impacts at the new intersection of the ramp and Rutherford Avenue. Design revisions have attempted to minimize impacts on BHCC property. Signalization of the new intersection and new pedestrian crosswalks will be designed to resolve traffic flow/truck access issues to the fullest extent possible.

Several members of Charlestown community object to the long duration of the temporary ramps linking the Central Artery North Area (CANA) project to the existing Central Artery, at City Square. In response to this comment, MHD is constructing temporary loop ramps connecting I-93 to the CANA tunnels, allowing removal of the existing temporary ramps.

There were requests to be aware of the historic skyline in the vicinity when designing the new bridge and to be sensitive to the newly created usable open space in the area. Design development attempts to minimize visual impacts on the historic skyline. Shadow analyses have been undertaken and conceptual landscaping plans of the newly created open space are being developed. The MDC has recently completed a parkland master plan for the Lower Charles River Basin. The conceptual framework of the MDC master plan is accommodated by Scheme Z and the three new design alternatives.

Another issue raised is the design of the ventilation building and the standards established by Federal and State air quality regulators. The design of the ventilation system will meet the National Ambient Air Quality Standards and State air quality standards.

The community requested that the routes of trucks carrying hazardous materials be clarified. Surface routes for the vehicles carrying hazardous materials are reevaluated and detailed in the DSEIS/R.

Opportunity For Further Public Comment. The general public will have the opportunity to review and comment on the DSEIS/R for the Charles River Crossing during the Federal and State environmental review processes. The general public will be notified of the official Public Hearing at which comments may be presented. These comments and written comments received during the public review process will be addressed in the Final SEIS/R.

8.2 PUBLIC AGENCIES

This section summarizes comments received from public agencies during the revised Charles River crossing coordination process.

8.2.1 Interagency Coordination

Since 1985, there has been a comprehensive process of interagency coordination, cooperation, and public scrutiny of the entire Project. In 1988, MHD established, in accordance with FHWA policy, a special agency review procedure for the Project pursuant to the cooperating agency concept under Federal environmental regulations. More than 30 Federal, State, and local agencies, including all of the agencies with permitting jurisdiction over the Project, have actively participated in the Project's preliminary and final design development and its associated environmental review process for several years through the cooperating agency program as defined under the National Environmental Policy Act (40 CFR Part 1500).

Representatives from several public agencies, including the EOE, MDC, MHC, City of Boston, and the City of Cambridge, are members of the Bridge Design Review Committee that was created by the Secretary of the Massachusetts EOTC pursuant to the Certificate issued by the Massachusetts Secretary of Environmental Affairs for the CA/T Project 1991 FSEIS/R. As described in Chapter 1, three design alternatives to Scheme Z for the Charles River crossing DSEIS/R evolved from the 1991 BDRC process and the subsequent 1992 Federal and State scoping processes.

Recognizing that environmental regulations often influence design decisions, MHD briefed the USACE, EPA, USCG, NMFS, the U.S. Department of Interior (DOI) and its agencies, EOTC agencies, EOE, and the City of Somerville concerning the design concepts for the Charles River crossing that evolved from the BDRC's process in the months prior to the September 1992 publication of the Revised Charles River Crossing NPC.

Following issuance, in early 1993, of the DSEIS/R scope requirements, Federal, State, and local agencies have been actively participating in the Project's conceptual design development and its associated environmental review process through the Interagency Coordinating Committee and three of its subcommittees, the Air Quality Subcommittee, the Water Resources Subcommittee, and the Cultural Resources Subcommittee. The mission and activities of these committees relative to this DSEIS/R are described in the following subsections.

8.2.1(a) Interagency Coordinating Committee

An Interagency Coordinating Committee was established in October 1986 to provide information about the entire Project to approximately 60 Federal, State, regional, and local agencies, and for MHD to receive feedback from the agencies. The committee meets monthly to facilitate this information exchange. Since publication of the NPC, the Interagency Committee has been briefed on the status of the design and environmental review process for the Charles River crossing at the monthly meetings of October 1992, March 1993, and July 1993.

Subcommittees were formed to encourage technical information exchanges and to resolve regulatory regulations. Several of these subcommittees have been actively involved in the development of this DSEIS/R through review and comment on the adequacy of its contents in accordance with their respective NEPA or MEPA responsibilities. The subcommittees and their activities relative to the DSEIS/R are described below.

Air Quality Subcommittee. The Air Quality Subcommittee, established in 1986, is comprised of air quality experts from the EPA, DEP, FHWA, the City of Boston Environment Department (BED), and Project staff. Its purpose is to collectively define air quality analyses, assumptions, protocols, and other criteria for the environmental documentation required by NEPA and MEPA that will meet the requirements of the 1990 CAAA, the MSIP, and the Massachusetts Certification Process for Roadway Tunnel Ventilation Systems in the Metropolitan Boston Air Pollution Control District (310 CMR 7.38).

The NEPA and MEPA processes require an air quality analysis to be performed to assess the potential environmental effects due to changes in emissions resulting from the three new design alternatives being proposed for the Charles River crossing. The assumptions and methodologies of the technical analysis described in a formal air quality protocol were developed by the Air Quality Subcommittee during several meetings in February and March of 1993, based on the original *Protocol for Air Quality Analysis for the Central Artery/Third Harbor Tunnel Project*, dated January 1989. The results of the application of this protocol are described in Air Quality Sections 4.3 (Long-Range Impacts) and 5.8 (Construction Impacts).

Recognizing that the Project's construction impacts will occur over an estimated 8- to 10-year period, FHWA, MHD, EPA, and DEP agreed in 1991 that a procedure was necessary to develop future measures to resolve potential construction impacts on air quality. A Memorandum of Understanding on air quality during construction between DEP, EPA, and FHWA was incorporated into the 1991 FSEIS/R Record of Decision. Its object is to provide a procedural framework for adjusting specific construction mitigation measures as needed to best achieve air quality objectives. The Construction Air Quality Committee, established under the MOU and comprised of EPA, DEP, BED, and FHWA air quality experts, meets at least quarterly for the duration of the Project to discuss the effects of the Project's construction on air quality. The Committee's activities include the following: review of traffic forecasting and air quality impact analyses, assessment of mitigation measures, review of staging and maintenance of traffic plans during final design, and approval of air quality monitoring methods and mitigation measures during construction.

Water Resources Subcommittee. Established in 1987, this subcommittee of the Interagency Coordinating Committee is a working group of Federal, State, and local agencies that have regulatory jurisdiction over or a special expertise in Project activities that affect either coastal or inland water resources. The Subcommittee is comprised of representatives of the USACE and its resource agencies as defined by Section 404(b)(1) of the Clean Water Act: EPA, FWS, NMFS, DOI, USCG, DEP, MCZM, MDC, BED, Boston Conservation Commission (BCC), and the Cambridge Conservation Commission (CCC).

The Committee's coordination efforts have emphasized integrating the Clean Water Act Section 404(b)(1) processes into the NEPA and MEPA environmental review process. The Section 404(b)(1) Guidelines require the analysis of practicable alternatives which avoid and minimize impacts to waters of the United States. By considering the Section 404 analysis during the preliminary design stages of the three alternatives, the Committee's intent is to preclude the necessity for modifications later in the design process. Most of the Committee members provided comments regarding this DSEIS/R scope. The three design alternatives and their environmental impacts were reviewed by the Committee at meeting held on March 18, April 22, and June 8, 1993. The Section 404 Permit application describing the design alternatives will be filed with the USACE concurrently with the publication of the DSEIS/R, and a public hearing regarding this permit application will be held concurrently with the DSEIS/R public hearing. All comments on the NEPA process that relate to the USACE's permit will be transmitted by the Project to the Corps District for incorporation into the public interest review process. These comments will be resolved by MHD to the satisfaction of the USACE prior the USACE decision to issue a permit. Subcommittee meetings subsequent to the publication of the DSEIS/R and permit application will focus on any resolution of conflicts among agencies relative to these documents.

Cultural Resources Subcommittee. This subcommittee was established in 1987 and is comprised of representatives from the USACE, MHC, FHWA, BLC, and Cambridge Landmarks Commission. Its purpose during the DSEIS/R process is to define Federal, State, and local regulatory requirements for baseline studies, archaeological excavation, documentation, archiving, and construction mitigation for historic structures.

An overview of the status of the revised Charles River crossing preliminary design and environmental review process was presented to the Subcommittee in April 1993. A formal presentation of the three design alternatives was provided by MHD in May 1993. MHD initiated formal Section 106 consultations with the MHC and BLC on June 10, 1993. These agencies have concurred on the resources present in the study area, on the likely potential effects, and on proposed mitigation measures.

8.2.2 Public Agency Participation In DSEIS/R Scoping

During the public review and comment period on the NPC, public scoping sessions for this DSEIS/R were held by the EOEA/MEPA Unit on November 4, 1992, and by FHWA on December 9, 1992. The following agencies attended the November 4, 1992, scoping session held by the MEPA Unit: USACE, U.S. General Services Administration, FHWA, Metropolitan Area Planning Commission, DEP, MDC, MCZM, CTPS, City of Boston, City of Cambridge, City of Somerville, BRA, Boston Fire Department (BFD), and BTB.

The following public agencies attended the scoping session held by FHWA: USCG, USACE, EPA, FTA, DEP, MBTA, Massachusetts Aeronautics Commission (MAC), Massachusetts Turnpike Authority (MTA), MDC, BTB, BED, BLC, BRA, BWSC, City of Cambridge, and the Cambridge Community Development Office.

Letters with written comments regarding the scope of this DSEIS/R were submitted by the following public agencies: DOI (FWS and National Park Service), USACE, FTA, NMFS, DEP, MCZM, MTA, Massachusetts Port Authority, MBTA, MWRA, MHC, Massachusetts Executive Office of Administration and Finance (Division of Capital Planning and Operations), BTB, BED, BLC, BFD, BRA, BWSC, City of Cambridge, City of Somerville, and the City of Somerville Planning Board.

8.2.3 Responses To Federal Agency Scoping Comments

8.2.3(a) Army Corps Of Engineers

MHD met with USACE in March 1992 to discuss the family of design options being developed by the BDRC and again in August 1992 to discuss the design alternative preferred by the BDRC, which included a river tunnel (see Section 1.3.3). USACE commented during the scoping process that there may be design options other than Alternative 8.1D Mod 5 which may have fewer temporary and permanent impacts to water and wetlands resource areas. USACE administers the Section 404 program regulating dredging and filling work in the waters of the U.S. USACE may issue a permit for this work only if it represents the "least environmentally damaging practicable alternative," provided that other alternatives do not have other significant adverse environmental consequences. In response to this concern, both the FHWA and MEPA scopes for this DSEIS/R require the review of a further design refinement to include a non-river-tunnel alternative as well as a reduced river tunnel alternative. See Section 4.5 for a detailed description of the environmental considerations to be analyzed under the Section 404 process.

USACE has been an active participant in meetings of the Water Resources Subcommittee in early and mid-1993 to discuss interagency issues relative to water quality, wetlands, navigation, waterways, land use, materials disposal, visual impacts and aesthetics. As described above, the Water Resources Subcommittee has and will continue to focus on the integration of the Section 404/NEPA environmental review processes during the development of the FSEIS/R.

8.2.3(b) Department Of Transportation, Federal Transit Administration

The FTA advised MHD that future North/South Station rail link development should not be precluded by the Charles River crossing design. As noted in Section 4.1.8(b), the rail link can be designed to be technically compatible with any of the four designs evaluated in this DSEIS/R. At the FTA's request, they have been included in the Cooperating Agency program for purposes of this Project, in accordance with 40 CFR 1506.2(c).

8.2.3(c) National Marine Fisheries Service

NMFS requested that the following impacts be analyzed and discussed in the DSEIS/R: potential shadow impacts of the bridge on fish migration; minimizing of Millers River fill, with compensation for any loss of functions and values; potential impacts of blasting on fish; minimizing turbidity during trench excavation and pier removal; assurance of anadromous fish migration during construction; options for disposal of dredged and excavated material; and an analysis of the effects of cofferdams and associated dewatering on water quality. These issues are discussed in Sections 4.5.4 and 5.10.4.

The Water Resources Subcommittee, of which NMFS is a member, agreed to determine wetlands mitigation measures following selection of the preferred alternative. As a result of consultation with the Water Resources Subcommittee members, the masterpile/sheetpile method of constructing any subaqueous tunnel alternative is expected not only to reduce the dredge quantities but also to reduce turbidity and protect water quality during construction.

In the near future, MHD, in coordination with the USACE, will request the NMFS Endangered Species section to review and comment on the discussion about the presence of, and potential impacts to, endangered species under their jurisdiction. MHD intends to request that the current USACE Section 404 permit be modified to include the disposal of acceptable dredged material from the Charles River crossing portion of the Project in the MBDS.

8.2.3(d) National Trust For Historic Preservation

The National Trust for Historic Preservation (NTHP) commended MHD for not only the process by which the revised Charles River crossing was developed, but also the improvement over the Scheme Z design. The NTHP encouraged MHD to continue to work with the BDRC to address unresolved issues and to work closely with the MHC regarding the MHC's concerns regarding the building at 100 Nashua Street and other historic resources in the construction vicinity.

MHD met with the BDRC several times in the development of the alternatives described in this document. The MHC reviewed the cultural resources section (Section 4.7) as part of the formal Section 106 consultation process that was initiated for purposes of this document in June 1993. Pursuant to the 1984 Section 106 MOA for the entire Project, potential impacts will be mitigated through design review by the Project Conservator and continued consultation with the historic agencies prior to construction.

8.2.3(e) Department Of The Interior, National Park Service

The NPS indicated that they would prefer the most direct route for motorists to reach the U.S.S. Constitution and the Charlestown Navy Yard unit of the Boston National Historic Park. The NPS supports reinserting Ramp C-L at City Square as in Scheme Z. All three new design alternatives relocate this ramp to Rutherford Avenue north of the Gilmore Bridge (see Section 4.1.2(a)). MHD has met several times with the NPS to discuss the impacts of this ramp relocation on motoring Park visitors, given the improved traffic conditions at City Square coupled with appropriate signage at Rutherford Avenue. Ramp reconfigurations have not been pursued by MHD at this time due to the potential impacts on riverbank parkland. Discussions with NPS will continue prior to the selection of a preferred alternative by MHD.

8.2.3(f) Department Of The Interior, Fish and Wildlife Service

The FWS indicated concern about fish migration in the Charles River, specifically, the ability to maintain a free zone of passage for spawning. Impacts to spawning, including the effects of shadows from the structure and mitigation that has been incorporated into construction staging, are described in Section 5.10.4. FWS also requested that sediment tests be conducted for dredged materials. Testing and evaluation will follow Project procedures as agreed upon by the Water Resources Subcommittee, of which FWS is an active member.

FWS also requested in their scoping comments analyses of several issues relating to Spectacle Island. Spectacle Island is not within the scope of this DSEIS/R.

FWS also believed that the DSEIS/R should also address project changes, new information obtained, and project agreements since 1991. The Project has filed and will continue to file Environmental Reevaluations and Notices of Project Change which address such issues in a manner consistent with regulatory requirements.

8.2.4 Responses To State Agency Scoping Comments

8.2.4(a) MEPA Certificate

In response to public comments regarding the NPC, the MEPA Certificate requires the inclusion of certain elements in the DSEIS/R. These requirements, and the sections where they are addressed in the DSEIS/R, are as follows:

- pursue further refinements to Alternative 8.1D Mod 5, and evaluate a non-river-tunnel alternative: impacts of the Reduced River-Tunnel Alternative and the Non-River-Tunnel Alternative are discussed in the DSEIS/R

- include several specific traffic analyses: Section 4.1.2
- discuss hazardous cargo transport routes: Section 4.1.4
- discuss in detail specific HOV facilities: Section 4.1.6
- confirm that none of the four design alternatives precludes a future rail link through the area: Section 4.1.8(b)
- address issues of tidelands and wetlands resources, and consider water- and nonwater-dependent aspects of the Project: Section 4.5.1 and 4.5.2
- provide detailed impacts and proposed mitigation plans for parklands: Section 4(f) Evaluation

8.2.4(b) Massachusetts Department Of Environmental Protection

The DEP expressed interest in several issues; comments, with the sections where they are addressed in the DSEIS/R, are as follows:

- identify potential CO "hotspots": Section 4.3.3
- include traffic levels of service at intersections: Section 4.1.2
- provide water-dependency determination narrative: Section 4.5.2
- provide more information regarding Millers River impacts: Sections 4.5.1 and 4.5.2
- coordinate Charles River navigation plans during construction with appropriate agencies: Section 5.10.3
- maintain pedestrian and vehicular access to the waterfront: Section 4.1.9
- adhere to CANA commitments: Sections 4.5.1 and 4.5.2
- assess dredge material and disposal options: Section 5.3

8.2.4(c) Massachusetts Coastal Zone Management

MCZM indicated a need for testing and disposal plans for the proposed dredging in the Charles River. A discussion of disposal options is presented in Section 5.3. Additional testing will be performed following selection of a preferred alternative.

8.2.4(d) Massachusetts Bay Transportation Authority

The MBTA provide detailed comments regarding impacts to their commuter rail operations, Green Line/Orange Line operations, Boston Engine Terminal, parking/MBTA garage operations, and air rights/land acquisition. Many of the issues can be addressed only during the final design stage. Impacts to transportation facilities during construction are described in Sections 5.3 and 5.1.6, and long-term impacts are described in Section 4.1.

8.2.4(e) Massachusetts Executive Office Of Administration And Finance, Division Of Capital Planning And Operations

The Division of Capital Planning and Operations (DCPO) expressed concern about the practicality of extreme mitigation measures being applied to 100 Nashua Street, a building that currently needs substantial repairs and improvements. MHD proposes to underpin 100 Nashua Street during construction of any of the new design alternatives, and undertake appropriate mitigation measures to protect its facade as required under the Section 106 MOA.

8.2.4(f) Massachusetts Historical Commission

MHC requested further review of construction mitigation measures that will be required for historic structures at 100 Nashua Street, Leverett Circle, and railroad Tower A. A description of proposed mitigation measures is included in Section 5.6. A discussion of the Section 106 consultation process appears in Sections 5.6 and 4.7.1.

As a member of the Cultural Resources Subcommittee, the MHC was briefed on the new design alternatives on May 18, 1993. The Section 106 consultation process for the protection of historic and archaeological resources was initiated in June 1993. In a series of meetings, descriptions of the properties, potential impacts, and proposed mitigation measures were discussed. MHC also reviewed the cultural resources section of this document as part of the consultation process. Pursuant to the 1984 Section 106 MOA for the entire Project, potential impacts will be mitigated through design review by the Project Conservator and continued consultation with the historic agencies prior to construction.

8.2.4(g) Massachusetts Port Authority

Massport requested an early review of signing plans for Tobin Bridge, a review of the temporary Tobin Bridge to CANA connections, and timely updates of traffic and design modifications for City Square and the I-93 HOV lane. MHD intends to continue its close coordination with Massport, including coordination relating to the above issues which are not relevant to the DSEIS/R.

8.2.4(h) Massachusetts Turnpike Authority

MTA stressed continued coordination with MHD and offered to share their studies of on/off ramps for the Massachusetts Turnpike and several surface arterial studies around the Charles River to assist the Project's traffic analysis. MTA requested clarification of construction staging at the downtown portals of the Sumner/Callahan Tunnels. Detailed construction staging will be available during final design.

8.2.4(i) Massachusetts Water Resources Authority

MWRA identified the need to closely coordinate the 96-inch force main relocation and other sewer works during final design and construction.

8.2.5 Response To Local Agency Scoping Comments

8.2.5(a) Boston Transportation Department

As the agency responsible for coordinating and communicating issues of concern on behalf of all City of Boston agencies, BTB's comments were extensive, and not restricted to traffic and transportation issues. Many of BTB's concerns are addressed in the 1991 FSEIS/R. The traffic and transportation issues are addressed in Sections 4.1, 5.1 and 5.2.

8.2.5(b) Boston Landmarks Commission

As a member of the Cultural Resources Subcommittee, the BLC was briefed on the new design alternatives on May 18, 1993. The Section 106 consultation process for the protection of historic and archaeological resources was initiated in June 1993. In a series of meetings, descriptions of the properties, potential impacts, and proposed mitigation measures were discussed. BLC also reviewed the cultural resources section of this document as part of the consultation process.

8.2.5(c) Boston Redevelopment Authority

The BRA submitted comments on traffic, transit, and land use impacts. Traffic and transit comments are discussed in Section 4.1. Land use impacts are in Section 4.2, with joint development specifically in Section 4.2.5. MHD will continue to coordinate with BRA on an ongoing basis regarding this Project.

8.2.5(d) Boston Water And Sewer Commission

BWSC requested further information regarding utility relocation plans for the West Side Interceptor and the Nashua Street Overflow. The Project will provide this information as it becomes available during further design development.

8.2.5(e) Boston Fire Department

The BFD indicated concern that hazardous cargo will be allowed in the CANA tunnels. It is MHD policy that all hazardous cargo movements will be prohibited from all tunnel segments of the Central Artery. It should be noted that there is an ongoing discussion between MHD and BFD regarding the use by hazardous cargo vehicles of the tunnels being constructed as part of the CANA Project, which is not part of the Central Artery/Tunnel Project, nor under its purview. The resolution of this issue will indicate whether or not a non-tunnel replacement route between Leverett Circle and Route 1/Tobin Bridge will need to be submitted to the LEPC for approval. A detailed discussion of hazardous cargo routes is located in Section 4.1.4.

8.2.5(f) City Of Cambridge

The City of Cambridge indicated its strong support of the revised Charles River crossing, and indicated its active participation in the BDRC. The City indicated its desire for close coordination with the Project on numerous design and construction period activities relative to traffic and air quality, materials disposal, utility relocation and enhancement, pedestrian access, ventilation building design, hazardous cargo routing, noise and vibration analyses, historic structure preservation, treatment of stormwater runoff, and wetlands mitigation.

MHD will continue to work closely with the City, a Cooperating Agency, through the environmental, design, and construction phases. The City is an active member of the Interagency Coordinating Committee and its Water Resources and Cultural Resources Subcommittees.

8.2.5(g) City Of Somerville

The City of Somerville indicated that the majority of the design modifications described in the NPC were in the best interests of Somerville and the Project. The City indicated concern regarding the potential location of a materials processing operation near Somerville, and also for construction impacts to the local street network especially McGrath Highway. Section 5.2.3 indicates that a materials processing operation is not being considered in this area at this time. The MHD will provide information regarding construction staging and maintenance of traffic as it becomes available during further design development of the preferred alternative, and will continue to coordinate with the City.

8.3 DOCUMENTS

The following documents are enclosed as reference:

The Commonwealth of Massachusetts, Executive Office of Environmental Affairs. *Certificate of the Secretary of Environmental Affairs on the Notice of Project Change*. EOEa, March 11, 1993.

Federal Highway Administration. *Proposed Scope of Work, SEIS, Revised Charles River Crossing, Central Artery (I-93)/Tunnel (I-90) Project, Boston, Massachusetts*. FHWA

Memorandum of Agreement. FHWA, SHPO, BLC, MDPW, ACHP, April 11, 1984.



The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street, Boston, 02202
March 11, 1993

WILLIAM F. WELD
GOVERNOR
RGEO PAUL CELLUCCI
LIEUTENANT GOVERNOR
SUSAN F. TIERNEY
SECRETARY

(617) 727-9800

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ON THE
NOTICE OF PROJECT CHANGE

PROJECT NAME :CA/T - Revised Charles River Crossing
PROJECT LOCATION :Area North of Causeway St., Boston
EOEA NUMBER :4325
PROJECT PROPONENT :Massachusetts Highway Department
DATE NOTICED IN MONITOR :October 7, 1992

Pursuant to the Massachusetts Environmental Policy Act (G.L., c.30, s.61-62H) and Section 11.17 of the MEPA regulations (301 CMR 11.00), I have reviewed the Notice of Project Change (NPC) submitted on the above project and hereby determine that it **requires** the preparation of a Supplemental Environmental Impact Report.

The NPC describes the Massachusetts Highway Department's (MHD) current plans for the portion of the Central Artery/Tunnel Project north of Causeway Street, and compares them to those contemplated in the Final Supplemental Impact Statement/Report (FSEIS/R). Specifically, a new configuration for the Charles River Crossing and associated roadway connections has been developed.

With respect to a number of significant environmental parameters, it is already clear that the current plan is far superior to the prior plan (i.e., Scheme Z). However, because of the scale of the project, additional studies must be prepared under MEPA. I ask that the next document submitted to MEPA be called a River Crossing Project Change Draft EIR. Even though I am requiring an SEIR, I anticipate the continuation of the joint Federal/State review process which has occurred to date.

The filing of this NPC represents the culmination of a lengthy and intensive effort to identify and develop alternatives to the river crossing proposal, known as "Scheme Z," described in the FSEIS/R. In the Certificate on the FSEIS/R, issued on

January 2, 1991, Secretary DeVillars strongly recommended that the MHD "continue to review modifications and options to Scheme Z, which might reduce the environmental and aesthetic impacts of the crossing, and to embark on a process to better inform the public about the crossing." The Certificate called for the formation of the Bridge Design Review Committee (BDRC), to be made up of representatives from the neighborhoods affected by the crossing, as well as from environmental, historic preservation, architectural, and transportation groups and agencies.

The BDRC was convened in February 1991. It had 42 members, who devoted countless hours to reviewing alternatives for the crossing, establishing priorities, and evaluating the traffic and environmental implications of the alternatives. The work of the BDRC was fully supported by the MHD, which provided extensive staffing support as well as funding for the work of experts in the fields of bridge design, tunnel construction, and the like.

The BDRC's review of over twenty alternatives led originally to the identification of three specific options, known as Committee Improvement Package (CIP) 3, CIP 5 and CIP 8. On June 21, 1991, the BDRC voted to recommend CIP 8.1, a modification of CIP 8 that further reduced the impacts of the loop ramps on open space along the Charles River. CIP 8.1 included the continuation of Storrow Drive north to I-93 and Route 1 connection in a tunnel under the river, and the I-93 and Route 1 southbound to Storrow Drive connection on the mainline bridge. The BDRC's second choice was CIP 5.3, which contained both Storrow Drive connections in tunnel. The third choice was CIP 3.1, which proposed a double-decker bridge crossing with Storrow Drive connections on the top level with no tunneling required.

The issues of primary concern to the BDRC were traffic and transportation, air quality, the impacts of the crossing on open space and land use, and the visual impacts of the bridge. The relative cost of the three options was also of concern, with CIP 3 being the least costly and CIP 8 the most costly.

The BDRC recognized that CIP 8.1 was not without challenges, however. These included the need to provide a dedicated High Occupancy Vehicle (HOV) system, a desire for an off-ramp from the northbound Artery to the Leverett Circle/Nashua Street area, the need to minimize impacts to parkland and historic resources, and issues relating to construction feasibility. The BDRC concluded, however, that CIP 8.1 best addressed the basic goals of the BDRC's mission: to improve, from both a transportation and an environmental point of view, the proposed Charles River crossing.

After the BDRC's designation of CIP 8.1 as the preferred alternative, further engineering was undertaken by BDRC members and MHD staff, in an attempt to address the concerns identified above. CIP 8.1D was the result. This modification contained a dedicated HOV lane and other refinements. Further design work through the summer of 1992 led to a further refinement known as

"CIP 8.1D Mod. 5." This is the version that MHD submitted in its Notice of Project Change.

According to the NPC, the new CIP 8.1D Mod. 5 plan includes the following:

1. The I-93 mainline highway will cross over the Charles River on a single bridge comprising four lanes each in northbound and southbound directions, plus an additional two lanes on the western side of the mainline bridge to carry I-93/Route 1 southbound traffic to Leverett Circle/ Storrow Drive. Thus, relative Scheme Z, the number of lanes has been reduced from 16 lanes to 10 and total width from 275 feet to 162 feet.
2. The bridge across the river will be a cable stayed structure with a single twin-legged tower approximately 285 feet in height along the north side of the Charles River. Height has thus been reduced by 45 feet from Scheme Z's 330 feet.
3. Access will be provided to the Boston Sand & Gravel site directly from Route 1 southbound, thereby eliminating the truck traffic on Charlestown streets that would have been part of Scheme Z.
4. I-93 southbound connections to Route 1, Storrow Drive and other points north and west are more direct and an exclusive High Occupancy Vehicle (HOV) lane will be provided from Sullivan Square to the north bank of the Charles River.
5. I-93 northbound connections to Storrow Drive and Route 1 will be via direct tunnel connections, as will Storrow Drive traffic that is heading north to I-93 or Route 1.
6. A ventilation building for the tunnels will be needed and is proposed to be located north of the new Boston Garden site where Spaulding Rehabilitation Hospital currently is located. Relocation of the hospital will thus be required.

Since the filing of the NPC, moreover, there have been improvements to the 8.1D Mod.5 design in an attempt to continue to address the elements of the design that are unresolved (for example, Leverett Circle). I consider these improvements to be part of 8.1D Mod. 5.

Due to concerns expressed by the Federal Highway Administration (FHWA) and other federal agencies about the amount

of tunneling involved in the CA/T project as a whole, the MHD has developed an alternative crossing design that eliminates the Charles River tunnels. In response to the federal scope, therefore, this non-tunnel alternative will also be evaluated in the EIS/R.

Additionally, I believe it would be prudent for the MHD to explore in the EIS/R further refinements to the 8.1D Mod.5 that address the concerns of the federal agencies while retaining as many of the advantages of that design as possible.

SCOPE

Combined State/Federal Review

The FHWA has made available a copy of the Proposed Scope of Work that for the Supplemental Environmental Impact Statement (SEIS) that is being required under NEPA. The FHWA outlines analyses to be performed for the following impact areas: Land Use; Cultural Resources; Traffic; Air Quality; Noise and Vibration; Aquatic Resources; Materials Disposal; Construction; and Parklands and Historic Resources (Section 4 (f)). I adopt the proposed scope, which is attached, and add other areas to be studied and clarified, as discussed below.

Alternatives

At a minimum, three alternatives must be evaluated and compared with respect to all impact areas in the Project Change EIR:

- 1) 8.1D Mod.5
- 2) No Tunnel
- 3) Reduced Tunnel

Other alternatives that may evolve as the planning continues, may be included in addition to these, or the MHD may file another Notice of Project Change to request that a particular alternative be eliminated from the Scope.

Transportation

The study area for the traffic analysis must include Leverett and Charles Circles as well as affected connections to

the Masspike and other important arterials.

Hazardous Material Transport

The comments indicate two sets of views regarding the transport of hazardous materials through the tunnels, including construction-related transport. On the one hand, there are concerns that the proposal will inflict undue hardship on the heating-oil industry because the proposal fails to provide a direct highway connection for flammable cargo from I-93 northbound to the CANA tunnels. At the same time, the City of Boston's Fire Department has indicated its intent not to permit hazardous cargo to use the tunnels. The report should discuss these considerations and explore alternatives that attempt to respond to them.

HOV Lanes

The EIS/R must provide a detailed discussion of the high-occupancy vehicle (HOV) facilities that are planned in the area north of Causeway Street. At a minimum, the following issues must be addressed:

- o the inclusion of a p.m. northbound HOV lane;
- o integration of HOV planning within the project limits with HOV planning currently underway for the I-93 north of the project boundary; and
- o provision of priority bus access from the HOV lane to Haymarket or another downtown bus terminal.

These issues are articulated in a thorough manner in the comment letter from the Conservation Law Foundation (CLF) dated November 23, 1992. I am incorporating this section of the CLF letter into this scope by reference.

Rail Link

A good deal of comment on the relationship between the CA/T and a future north-south rail link has been generated by this NPC, urging me to require a study of a North Station/ South Station rail link as part of this scope. Consistent with how projects are normally handled while being reviewed under MEPA, I am requiring this report to demonstrate that the revised Charles River Crossing proposals will not preclude options for the rail link. Furthermore, the report must provide an update as to the

status of a rail link study that I understand is underway. I also challenge the MHD, to the extent that a rail link moves forward, to optimize coordination between it and the CA/T project, both in terms of cost and construction-related issues.

I am not requiring that a North Station/South Station rail link be included as part of the CA/T project. While I have received many comments urging me to include the link as part of this project, I do not believe it is integral to that portion of the project that is before me in this Notice of Project Change.

Chapter 91/Wetlands

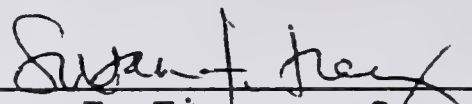
The report must carefully address concerns related to the proposed impact on tidelands and wetland resources that are raised in the comments from the Division of Wetlands and Waterways, the City of Cambridge, and from others. The EIS/R should consider the issues of water dependency vs. non-water dependency for relevant pieces of the project, and develop mitigation as warranted.

Parkland

The report must detail impacts and proposed plans for mitigation to parklands. Commitments for parkland mitigation should be depicted clearly, including an explanation as to the status of parkland mitigation commitments made in the SFEIS/R.

March 11, 1993

DATE



Susan F. Tierney, Secretary

Attachment

Comments received :

Committee for Regional Transportation	11/24/92
National Trust for Historic Preservation	11/24/92
Boston Transportation Department	11/24/92
Astrid Glynn (for Mass.Oilheat Council)	11/24/92
Harvard Grad School of Design (Pollalis)	11/24/92
Boston Organizing Committee	12/03/92
Clark Frazier	11/24/92
MBTA	11/25/92
Macomber Development Associates	11/25/92

PRA	11/25/92
Hugh Russell	11/25/92
Mass. Historical Commission	11/25/92
G.Conway, Inc.	12/04/92
MHD (meeting announcement)	11/27/92
National Trust for Historic Preservation	11/27/92
BRA	11/25/92
Harvard Grad School of Design (Pollalis)	11/27/92
City of Cambridge	11/23/92
Sierra Club	11/23/92
Liberty Bell Grocery	11/23/92
K.Dun Gifford	11/24/92
DEP	11/23/92
Stephen Kaiser	11/23/92
William Lamb	11/23/92
The Mass. General Hospital	11/23/92
Conservation Law Foundation	11/23/92
Conservation Law Foundation	11/23/92
Downtown North Association, Inc.	11/23/92
City of Boston- Env.Dept.	11/24/92
Boston Landmarks Commission	11/24/92
Massport	11/24/92
MHD	11/23/92
Boston Fire Department	11/17/92
Charlestown Preservation Society	11/18/92
Boston Edison	11/20/92
MWRA	11/23/92
The ad hoc Coalition	11/23/92
Beacon Hill Civic Association	11/23/92
New England Telephone	11/19/02
Raffi Berberian	11/19/92
Alice Templeton	11/19/92
Rappaport & Rakov law offices	11/19/92
Charlestown North Area Task Force	11/20/92
Rosemary Kverek	11/20/92
Boston Area Bicycle Association	11/20/92
Mass Audobon Society	11/20/92
Museum of Science	11/06/92
William J. Galvin Jr.	11/05/92
Brotherhood of Locomotive Engineers	11/09/92
Bunker Hill Community College	10/29/92
Boston Water and Sewer Commission	10/29/92
MDC	10/05/92
Carr, Lynch, Hack & Sandell	10/29/92
MHD	10/02/92
MHD	10/14/92
Charles Bahne, Jr.	10/22/92

Campaign for New Transportation Priorities	11/16/92
Walk Boston	11/20/92
City of Somerville	11/23/92
Somerville Planning Board	11/23/92
Mass CZM	11/23/92
Anthony Pangaro	11/30/92
Judith M. Brennan	11/23/92
Boston Society of Architects	11/23/92
Frank Saviano	11/23/92
Charles River Watershed Association	11/23/92
Citizens for a Liveable Charlestown	11/23/92
Engineers Training Center	11/23/92
Division of Capital Planning/ Operations	11/23/92
MHD	11/27/92
Boston Sand & Gravel Co.	11/30/92
Charlestown Neighborhood Council	11/30/92
Artery Business Committee	11/30/92
Harvard Grad School of Design (McIntosh)	11/30/92
MHD	11/06/92
Bridge Design Review Committee	11/16/92
Stephen Kaiser	11/02/92
Hale and Dorr	11/04/92
Boston Thermal Energy Corp.	11/04/92
Transportation Action Campaign	11/02/92
Bridge Design Review Committee	2/19/93
Downtown North Association, Inc.	2/22/93
Boston Preservation Alliance	2/28/93
Boston Transportation Department	2/23/93
Downtown North Associattion, Inc.	2/26/93
Charles River Watershed Association	2/24/93
Beacon Hill Civic Association	3/1/93
Citizens for a Liveable Charlestown	3/1/93
Pangaro	3/1/93
Lamb	3/1/93
Cambridge City Manager	3/1/93
Artery Business Committee	3/1/93
Move Massachusetts 2000	3/1/93
Massachusetts General Hospital	3/1/93
Charlestown North Area Task Force	3/1/93
Boston Transportation Department	3/3/93
MCZM	3/4/93
Conservation Law Foundation	3/2/93
Beacon Hill Civic Association	3/9/93
SFT/	

**Federal Highway Administration
Proposed Scope of Work**

**Supplemental Environmental Impact Statement
Revised Charles River Crossing**

**Central Artery (I-93)/Tunnel (I-90) Project
Boston, Massachusetts**

A third supplemental environmental impact statement (SEIS) is required for the above referenced project. Design changes are recommended by the Massachusetts Highway Department, the proponent, in the FSEIS subarea called Area North of Causeway Street. The FSEIS was approved on February 28, 1991 and the Record of Decision was signed on May 11, 1991. The scope of the SEIS for the Revised Charles River Crossing consists of the following:

Project Limits. The geographic area covered in this SEIS is the same as in the Area North of Causeway Street in the FSEIS, with the following changes: Deletion of a tunnel under and west of Leverett Circle, decreasing the length of reconstruction of a portion of Storrow Drive to only approximately 450 feet west of Leverett Circle; and the extension of the northern project limits approximately 2,000 feet north to near Sullivan Square in Somerville to incorporate a high-occupancy vehicle (HOV) lane on I-93 southbound and the relocation of the I-93 off-ramp from the City Square area to New Rutherford Avenue to a point approximately 1,900 feet north of Gilmore Bridge.

Comparison of changes to Proposed Action in FSEIS. The focus of this SEIS is to identify the difference in impacts and mitigation measures between the Proposed Action in the FSEIS and the proposed Revised Charles River Crossing. The Revised Charles River Crossing and existing conditions will be compared for the air quality and noise impact technical analyses. The existing baseline conditions in the FSEIS will be reevaluated.

Technical Analyses To Be Undertaken.

- 1) **Land Use.** The impacts of the I-93 northbound off-ramp to New Rutherford Avenue on Bunker Hill Community College, on the industrial district to its north and on the residential community across New Rutherford Avenue in Charlestown will be evaluated. The impacts of new displacements, particularly the Spaulding Rehabilitation Hospital and Boston Thermal Minot Station, will be evaluated including the future reuse of portions of parcels not required for the right-of-way. In addition, the joint development impacts on property owned by Massachusetts General Hospital along Nashua Street, including the Spaulding Rehabilitation Hospital site, will be evaluated.
- 2) **Cultural Resources.** Changes to historical and archaeological resources in this project subarea will be reevaluated, according to Section 106 of the National Historic Preservation Act. Of particular interest are the Registry of Motor Vehicles Building at 100 Nashua Street, the Bullfinch Triangle and Tower A (railroad facility).

- 3) **Traffic.** The design year for traffic predictions remains the same as in the FSEIS, 2010. Traffic data to be provided will be in the same categories and format provided in the FSEIS. Specifically the following data will be used: AWDT for designated locations; peak hour volumes for designated locations; screenline crossings, daily; LOS, speeds on relevant sections of highway; queue lengths, travel times through redesigned sections; operations at selected intersections, i.e., major intersections close to Charles River crossing and any intersections affected by redesign; VMT and VHT; hours of congestion; truck movements, hazardous cargo transportation (qualitative); and accidents.

The study area traffic network will be extended north along the I-93 corridor to north of the Mystic Avenue interchange. This will provide more precise data regarding the split of traffic between the expressway and local street approaches to the Charles River crossing from the north. Additional intersections in Charlestown and east Cambridge will be analyzed.

The Leverett Circle intersection design aspects, traffic signalization, access to Nashua Street from Charles Street Extension, pedestrian paths, and integration with the MBTA'S Green Line Science Park station, will be further analyzed.

Additional analysis of intersection operations will be performed to optimize signalization and traffic flow on surface streets. Several intersections along New Rutherford Avenue (at City Square, at the Boston Sand & Gravel Access Road, and at the Ramp C-L intersection) will undergo design and traffic signal analysis. Design of the intersection of the proposed New Sudbury Street on-ramp with New Sudbury and Cross Streets will require additional evaluation.

Impacts to pedestrian/bicycle facilities in the area will be evaluated and specific plans to enhance these facilities will be identified.

The scope of the North Station-South Station rail link study being undertaken by the Federal Transit Administration will be evaluated as to the effects on the Area North of Causeway Street. In particular, the alternatives FTA is studying will be evaluated to make certain the Central Artery/Tunnel Project in this subarea does not preclude future rail link development.

A literature search on the human factors of driving through tunnels will be conducted to provide new information for tunnel design consideration.

- 4) **Air Quality.** A detailed air quality assessment will be undertaken to confirm that the Revised Charles River Crossing including any new ventilation building (s), will comply with the requirements of the 1990 Clean Air Act Amendments, the Massachusetts State Implementation Plan, and the Massachusetts Ventilation Building certification regulation.

The air quality analysis will include the following:

- An evaluation of the carbon monoxide (CO) levels at critical locations that are expected to be affected by these design changes, included but not limited to those evaluated in the surrounding area of the FSEIS Proposed Action.

- An impact analysis on regional levels for CO, hydrocarbons, nitrogen oxides, and particulate matter (PM₁₀) pollutants.
- An impact analysis of the emissions from the new ventilation building for CO, NO₂, and PM₁₀.
- Both analytical and physical (wind tunnel testing) air quality modeling will be performed for the ventilation building.

- 5) **Noise and Vibration.** The monitoring sites that were analyzed for the FSEIS Proposed Action in the Area North of Causeway Street will be reevaluated. Additional sites will be selected for noise monitoring, prediction of future noise monitoring, and prediction of future noise levels in areas which would be potentially affected by the Revised Charles River Crossing. FHWA model predictions of noise levels at monitoring locations, due to increase in project size, and whether or not they meet FHWA Noise Abatement Criteria, will be determined. If criterion exceedences are noted, mitigation measures such as noise barrier walls will be evaluated after performing a detailed abatement analysis.

Temporary construction noise impacts will be evaluated because of work near sensitive locations (e.g., Spaulding Rehabilitation Hospital, Suffolk County Jail and Bunker Hill Community College recreational facilities).

Operational vibration is not an issue. However, baseline vibration levels will be measured at critical structures. The potential effect of construction vibration on the Spaulding Rehabilitation Hospital, Registry of Motor Vehicles building and the Suffolk County Jail will be evaluated.

- 6) **Aquatic Resources.** Pursuant to the Massachusetts Wetlands Protection Act, the Massachusetts Chapter 91 process, and the U.S. Army Corps of Engineers (USACE) Section 404 regulations the impacts on wetlands and waterways due to a new tunnel in the Charles River, construction of an adjacent graving basin and a tunnel section storage area will be evaluated further.

The Revised Charles River Crossing concept will be submitted to the USACE to trigger the Highway Methodology review that will be used to select the least damaging practicable alternative for the design elements affecting aquatic resources in the Charles and Millers Rivers. Measures to avoid or minimize impacts will evolve from this process resulting in final design.

Mitigation measures for impacts to the Millers River will be developed in conjunction with regulatory agencies. The impact of additional construction in waterways and historic filled tidelands (i.e., Chapter 91) will be reevaluated.

- 7) **Materials Disposal.** Dredged and excavated material must be removed from the project site and disposed of properly or beneficially, consistent with the overall project Materials Disposal Plan and the USACE Section 404 process. Boring data of subsurface conditions will be developed in order to estimate relationships between characteristics of excavated and dredged material and suitable disposal sites.

8) **Construction Impacts.** The following key impact areas will be evaluated:

- Construction and operation impacts on navigation in the Charles River will be reevaluated in coordination with the U.S. Coast Guard (USCG), Metropolitan District Commission (MDC), Massachusetts Division of Wetlands and Waterways (DWW), USACE, and other appropriate agencies. A navigation maintenance plan will be developed.
- The construction plan for the Area North of Causeway Street will be revised to the same level of detail as in the FSEIS and its construction appendices.
- A revised Maintenance of Traffic Plan will be prepared indicating potential detours and their duration.
- The following construction sequence impacts will be estimated: traffic volumes, CO levels at affected intersections, areawide emissions and construction-related fugitive dust near major construction sites. Coordination with the interagency committee established pursuant to a post FSEIS Memorandum of Understanding will continue.
- A revised utility relocation plan consistent with the overall construction plan will be developed.
- The construction impacts of the revised design on historic resources in the sub area will be reevaluated.

9) **Section 4 (f) Evaluation.** The Final Section 4 (f) Evaluation in the FSEIS will be reevaluated and revised, as appropriate, due to changed impacts to parklands and historic resources.

- The mitigation program will be reevaluated and revised to reflect new or reduced impacts because of the RCRC design.
- No additional work on archaeological resources is necessary.

MEMORANDUM OF AGREEMENT

WHEREAS, the Federal Highway Administration (FHWA) has determined that the Third Harbor Tunnel, Interstate 90/Central Artery, Interstate 93 will have an adverse effect upon properties included in or eligible for inclusion in the National Register of Historic Places and has requested the comments of the Advisory Council on Historic Preservation (Council) pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. 470f) and its implementing regulations, "Protection of Historic and Cultural Properties" (36 CFR Part 800),

NOW, THEREFORE, FHWA, the Massachusetts State Historic Preservation Officer (SHPO), and the Council agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effects of the undertaking on historic properties.

Stipulations

1. HISTORIC AMERICAN BUILDING SURVEY (HABS) / HISTORIC AMERICAN ENGINEERING RECORD (HAER) RECORDING.

FHWA will ensure that prior to alteration or demolition of the properties listed below, HABS/HAER (National Park Service, Mid Atlantic Regional Office, 143 South Third Street, Philadelphia, PA., 19106; Mr. John Hnedak (215) 597-1577) will be contacted to determine the level of documentation required to provide a permanent record of the properties. First, a list of the properties, with a summary of their National Register significance (the description given in the case report), will be forwarded to HABS/HAER. All documentation must be accepted by HABS/HAER and the Massachusetts State Historic Preservation Officer (SHPO) prior to alteration or demolition of the properties.

This stipulation refers to the following list of properties:

Fort Point Channel
Summer Street Bridge
Old Colony Railroad Bridge
Charles River Building
Stop and Shop Building

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Third Harbor Tunnel/Central Artery
Boston, Massachusetts

2. FORT POINT CHANNEL DESIGN DEVELOPMENT GUIDELINES

FHWA will ensure that design development in this area will include the following:

- a. Design and location of the ventilation building in a manner that is sympathetic to, and respectful of, the characteristics of surrounding historic properties with regard to massing, color, building material, detail, and scale.
- b. Granite facing will be used in the new section of the Fort Point Channel bulkhead to make it visually consistent with the existing bulkhead in color, texture, configuration, and design.
- c. Reconstruction of the one span of the Summer Street Bridge removed during project construction will be in a manner that reuses as much original fabric as possible and results in the same configuration as the original.
- d. Landscaping improvements along the Boston side of the Channel will be designed to enhance those characteristics of the historic district that make it eligible for listing in the National Register of Historic Places.
- e. During preliminary project design, there will be continuing study and negotiation with the U.S. Postal Service concerning the use of land between the existing Dorchester Avenue and the Channel bulkhead for project right-of-way. The final design of the new Dorchester Avenue will be such as to minimize impacts to the historic characteristics of Fort Point Channel and adjacent historic resources, including impacts related to pedestrian and vehicular traffic flow.
- f. Preliminary and final design, and construction specifications, will be submitted to the Massachusetts SHPO, prior to start of construction, for review and approval in consultation with the Boston Landmarks Commission (BLC) regarding consistency with the design development guidelines outlined above.

3. STOP AND SHOP BAKERY BUILDING LOADING DOCK RELOCATION.

FHWA will ensure that the loading facilities of the Stop and Shop Bakery Building, a building included in the Causeway/North Washington Streets District, a property eligible for listing in the National Register, will be modified either to continue present operations or to serve an alternative building use with lesser loading requirements, in order to

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ensure the continued economic viability of the building. Preliminary and final design and construction specifications for the building modification shall be reviewed and approved by the SHPO in consultation with the BLC.

4. REVIEW OF DESIGN AND CONSTRUCTION SPECIFICATIONS

FHWA will ensure that potential adverse construction effects on all historic properties described in its Preliminary Case Report are minimized or avoided through appropriate preliminary and final design and construction specifications, reviewed ~~and approved~~ by the SHPO in consultation with the BLC, and through the appointment to the project design team by the MDPW a Project Conservator. The Project Conservator's job description and qualifications shall be approved and his/her ongoing responsibilities reviewed by the SHPO in consultation with the BLC. The Conservator's responsibilities shall involve overseeing the development of measures for mitigating the adverse effects of construction on standing historic properties. These mitigation measures shall be included as part of the construction specifications.

5. JOINT DEVELOPMENT DESIGN GUIDELINES

a. FHWA will ensure that potential adverse effects (as defined in Section 800.3(b) of the Council's Regulations, "Protection of Historic and Cultural Properties" (36 CFR Part 800)) from the use of air-rights and other joint development ventures, and the development of ventilation structures, and surface street improvements on historic properties described in FHWA's Preliminary Case Report will be minimized or avoided through appropriate design. Design guidelines will be developed by the Massachusetts Department of Public Works, in consultation with the Massachusetts SHPO, BLC, and other interested groups, for joint development affecting such properties.

b. Preliminary and final design and construction specifications for joint development ventures, as they affect historic properties described in FHWA's Preliminary Case Report, will be reviewed and approved by the Massachusetts SHPO in consultation with BLC for consistency with the above design guidelines. The MDPW shall ensure, as a condition to disposal of joint development and air rights parcels, compliance with this stipulation prior to and following parcel disposition.

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Boston, Massachusetts

6. ARCHAEOLOGY

A. Identification and Evaluation

1. Based on the preliminary Phase I (Step 1) survey work already conducted, FHWA shall ensure that a Phase I, Step 2/Phase II archaeological investigation of the project's proposed area of environmental impact be conducted in consultation with the MDPW, SHPO and BLC. This investigation will be initiated 90 days following ratification of this Agreement and release of funds for additional planning and design studies. This investigation shall include, at a minimum, the following elements:

(a) Preparation of an appropriate research design, outlining and justifying important research problems that may be addressed by investigation of archaeological resources in the project area, and a proposed scope of work and work plan for field investigation integrating the results of the following:

- (1) Acquisition of additional historical and engineering/utility documentaton on past disturbances that may preclude areas from field testing;
- (2) Acquisition of additional historical documentary information concerning potential significance of historic and prehistoric archaeological sites and their eligibility for nomination to the National Register of Historic Places.

(b) This program for investigation including the research design, scope of work and work plan will be reviewed by MDPW and the SHPO prior to implementation.

2. Implementation of field testing and evaluation based on the scope of work and work plan and in the context of the research design.

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3. A written report describing the results of the , documentary research, field testing and applied National Register criteria 36 CFR Part 63 and containing recommendations on the significance of identified resources, will be provided to MDPW, the Massachusetts SHPO, and BLC. These recommendations will be subject to review by MDPW and the Massachusetts SHPO in consultation with BLC.

B. Treatment and Additional Studies

Based on the results of the documentary research and field testing work, a plan will be developed in consultation with MDPW, the Massachusetts SHPO and BLC that includes provisions for avoidance or preservation in place of significant archeological remains, where feasible and practical, through design and engineering development or construction specifications as set forth in Stipulation 4 above. If avoidance or preservation in place is not feasible and practical, and the Massachusetts SHPO concurs in this determination, the plan will include provisions for Phase III data recovery or other appropriate treatment consistent with the Council's Handbook, Treatment of Archaeological Properties (Attachment 1). The plan will be submitted to the Massachusetts SHPO and the Council for review and approval in consultation with BLC prior to implementation.

C. Performance Standards

1. All historic and archaeological investigations called for under Stipulation 5.a. and b. above will be conducted by qualified individuals who meet, at a minimum, the appropriate qualifications in "Professional Qualifications" contained in the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (Attachment 2) and in a manner consistent with those Standards and Guidelines and the Council's Handbook (Attachment 1).

2. Curation arrangements and materials conservation will be agreed upon by the MDPW and Massachusetts SHPO in consultation with BLC. Copies of final technical reports and papers resulting from the investigations will be provided to the Massachusetts SHPO, the National Park

Memorandum of Agreement
Third Harbor Tunnel/Central Artery
Boston, Massachusetts

Service, BLC, interested local academic institutions, and the Council. A camera ready copy of a popular report suitable for local public dissemination describing the results of any significant archaeological data recovery will be prepared for the project.

7. The Massachusetts SHPO shall review within 30 days of receipt any documents submitted by FHWA in accordance with any of the stipulations written above. Failure by the Massachusetts SHPO to respond within 30 days of receipt of any complete documents from FHWA shall be deemed to constitute full approval of such documents under the stipulations written above. If the Massachusetts SHPO and FHWA fail to agree, then the agency shall submit documentation to the Council and request consultation under 36 CFR 800.6.

Execution of this Memorandum of Agreement evidences that FHWA has afforded the Council a reasonable opportunity to comment on the Third Harbor Tunnel, Interstate 90/Central Artery, Interstate 93 and its effects on historic properties and the FHWA has taken into account the effects of its undertaking on historic properties.

James G. Walsh 2/24/84
(date)
Federal Highway Administration

Patricia L. Westowski (date) 2/27/84
Massachusetts State Historic
Preservation Officer

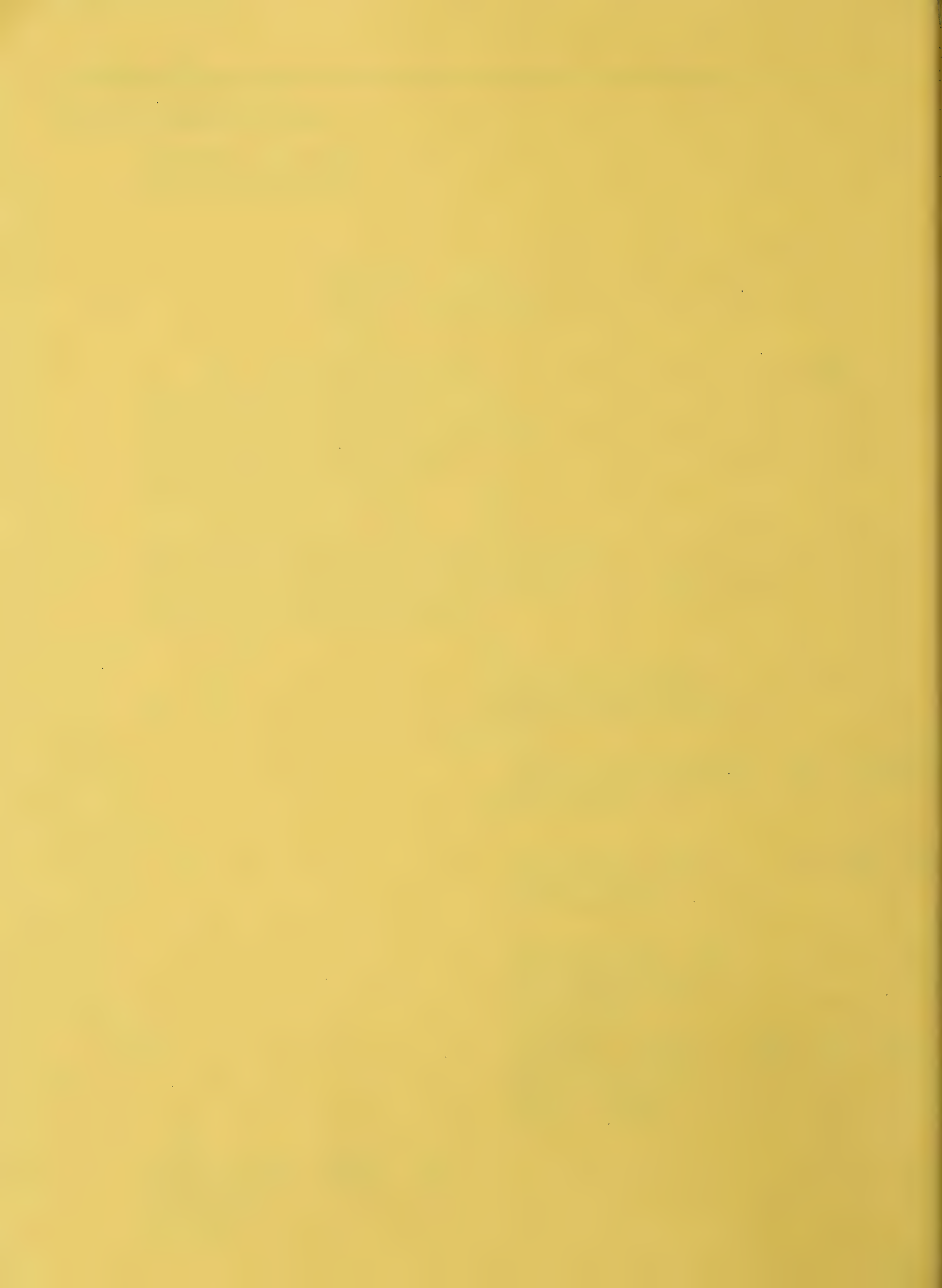
Marcia Myerson (date) 2/29/84
Executive Director
Boston Landmarks Commission

Robert J. McDonagh (date) 2-26-84
Chief Engineer
Massachusetts Department of Public Works

Robert Dawley April 5, 1984
Executive Director
Advisory Council on Historic Preservation

Alexander Kluckhohn (date) 4/11/84
Chairman
Advisory Council on Historic Preservation

9. List Of Abbreviations



Chapter 9

LIST OF ABBREVIATIONS

AAQS	Ambient Air Quality Standards (Federal and State)
AWDT	Average weekday daily traffic
BDRC	Bridge Design Review Committee
BFD	Boston Fire Department
BHCC	Bunker Hill Community College
BLC	Boston Landmarks Commission
BLSF	Bordering lands subject to flooding
BRA	Boston Redevelopment Authority
BSG	Boston Sand & Gravel Company
BTD	Boston Traffic Department
Btu	British thermal unit
BVW	Bordering vegetated wetlands
BWSC	Boston Water and Sewer Commission
CAAA	Clean Air Act Amendments of 1990
CAD	Confined aquatic disposal
CANA	Central Artery North Area Project (i.e., I-93/Route 1 Interchange in Charlestown)
CARLTF	Central Artery Rail Link Task Force
CERCLA	Comprehensive Environmental Response, Comprehensive Liability Act
cfs	Cubic feet per second
CIP	Committee Improvement Package (name used by BDRC for different design options)
CO	Carbon monoxide
CSO	Combined sewer overflow
cy	Cubic yards
CZM	Coastal Zone Management
dBA	A-weighted decibel (a noise measurement)
DCPO	Department of Capital Planning and Operations (State)
DEP	Department of Environmental Protection (State)
DSEIS/R	Draft Supplemental Environmental Impact Statement/Report (1993)
DWPC	Division of Water Pollution Control (State)
EDA	Economic development area
EOEA	Executive Office of Environmental Affairs (State)

EOTC	Executive Office of Transportation and Construction (State)
EPA	Environmental Protection Agency (Federal)
FAR	Floor area ratio
FEIS/R	Final Environmental Impact Statement/Report (1985)
FHWA	Federal Highway Administration
FSEIS/R	Final Supplemental Environmental Impact Statement/Report (1991)
FTA	Federal Transit Administration
GEP	Good engineering practice
HC	Hydrocarbon
HOV	High-occupancy vehicle
in/sec	inches per second
L eq	Equivalent noise level
LEPC	Local Emergency Planning Committee (Boston)
lf	Linear foot
LOS	Level of service (traffic)
LUW	Lands under water
MAC	Massachusetts Aeronautics Commission
MBDS	Massachusetts Bay Disposal Site
MBTA	Massachusetts Bay Transportation Authority
MDC	Metropolitan District Commission
MEPA	Massachusetts Environmental Policy Act
MGH	Massachusetts General Hospital
MHC	Massachusetts Historical Commission
MHD	Massachusetts Highway Department
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
mph	Miles per hour
MPO	Materials Processing Operation
MTA	Massachusetts Turnpike Authority
MWRA	Massachusetts Water Resources Authority
NAC	Noise Abatement Criteria (FHWA)
NATM	New Austrian Tunnel Method (construction)
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service

NO	Nitric oxide
NO₂	Nitrogen dioxide
NO_x	Nitrogen oxide
NPC	1992 Notice of Project Change for Revised Charles River Crossing (i.e., Alternative 8.1D Modified 5)
NPDES	National Pollution Discharge Elimination System
NS	Non support
NWS	National Weather Service
O₃	Ozone
OLM	Ozone Limiting Method
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PHC	Petroleum hydrocarbon
PM₁₀	Particulate matter smaller than or equal to 10 microns
ppm	Parts per million
PSD	Prevention of Significant Deterioration
PVF	Principal Value Functions
RCRA	Resources Conservation Recovery Act
ROW	Right-of-way
sec/veh	Seconds per vehicle
SEIS/R	Supplemental Environmental Impact Statement/Report
sf	Square foot
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan (for air quality)
TDC	Transcontinental Development Corporation
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
v/c	Vehicle to capacity ratio
VHT	Vehicle hours of travel
VMT	Vehicle miles of travel
VOC	Volatile organic compound
vph	Vehicles per hour
WET	Wetlands Evaluation Technique
μg/m³	Micrograms per cubic meter

Section 4(f) Evaluation

Draft Section 4(f) Evaluation

1 INTRODUCTION

1.1 Background And Purpose Of The Draft Section 4(f) Evaluation

This chapter provides information and evaluation to support the Federal Highway Administration's (FHWA) determination under Section 4(f) of the Department of Transportation Act of 1966 regarding the Charles River crossing. This determination is to be made after selection of a preferred alternative in the FSEIS/R. Section 4(f) is a Federal law which strongly protects significant public parklands and historic resources from impairment by transportation projects. Only where a project proponent affirmatively demonstrates that there is no feasible and prudent alternative, is any encroachment allowed on a public park or historic property. If such parkland or historic impacts are unavoidable, Section 4(f) ensures that project design and mitigation measures will minimize or compensate for these impacts.

This chapter addresses the 4(f) impact of the three new design alternatives for the Charles River crossing, compares them to the impacts of the 1991 FSEIS/R Proposed Action (Scheme Z), and discusses proposed mitigation in order to demonstrate all possible planning to minimize harm. Parkland mitigation appropriate to these alternatives is discussed in the context of all 4(f)-protected parkland in the Area North of Causeway Street. Open space which is not parkland, and which is therefore not subject to Section 4(f), is addressed in Section 4.2.2 of this DSEIS/R.

2 COORDINATION

The Metropolitan District Commission (MDC) is the agency having jurisdiction over parklands along the Charles River which are affected by the Charles River crossing. Pursuant to the Massachusetts Highway Department's (MHD) mitigation commitments in the 1991 FSEIS/R, MHD and MDC executed a Memorandum of Agreement (MOA) regarding implementation of park mitigation measures for the 1991 Proposed Action, beginning with funding of MDC parkland master planning for the area. MHD and the MDC are currently engaged in ongoing work to develop early phases of Project mitigation measures as provided in the MOA, and this joint work will continue based on the preferred alternative, when selected.

The MDC master plan is now substantially complete. The master plan reflects the park agency's objective of creating a continuous riverfront park and pedestrian pathway system between the old and new Charles River dams, and it describes the potential future uses, values, and functions that were documented in the 1991 FSEIS/R. These elements provide an overall framework for continued analysis of the impacts of new Charles River crossing alternatives, and of the measures to minimize harm presented in this DSEIS/R.

In addition, the MDC master plan proposes a series of detailed park design concepts and programming initiatives for future MDC action. While these proposed MDC actions are consistent with the framework of future uses, values, and functions upon which Section 4(f) mitigation rests, the manner in which they are accomplished is independent of the Project mitigation commitments. Such details of the master plan are, accordingly, not part of this Section 4(f) Evaluation; however, MHD remains committed to working closely with the MDC throughout Project development and construction, to facilitate realization of the MDC's overall vision for the Charles River Basin parkland system as a whole.

During the preparation of this Draft Section 4(f) Evaluation, MHD met with the MDC staff to agree on the characterization of planned park use, to discuss how the alternatives would affect planned use, and to refine plans for minimization of harm which are consistent with the MOA mitigation plans, but anticipating specific adjustments for the new alternatives now being considered. Review drafts of this Section 4(f) Evaluation were provided to the MDC, for its review and comment. This coordination effort will continue throughout the environmental review and design process.

Rendered models pictured in this DSEIS/R are MHD's adaptations of the detailed master plan proposals, which were developed by the MDC. These adaptations are illustrative only, and do not represent the MHD mitigation commitments or proposals; further coordination with the MDC will be undertaken to address how its master plan may be adapted to the specific features of the selected alternative to be identified in the FSEIS/R.

Bunker Hill Community College (BHCC) athletic facilities are affected by a ramp which is common to all three new design alternatives. MHD has met with BHCC officials and the Massachusetts Higher Education Coordinating Council regarding the use of these facilities. MHD will continue to work with BHCC to develop measures to minimize harm.

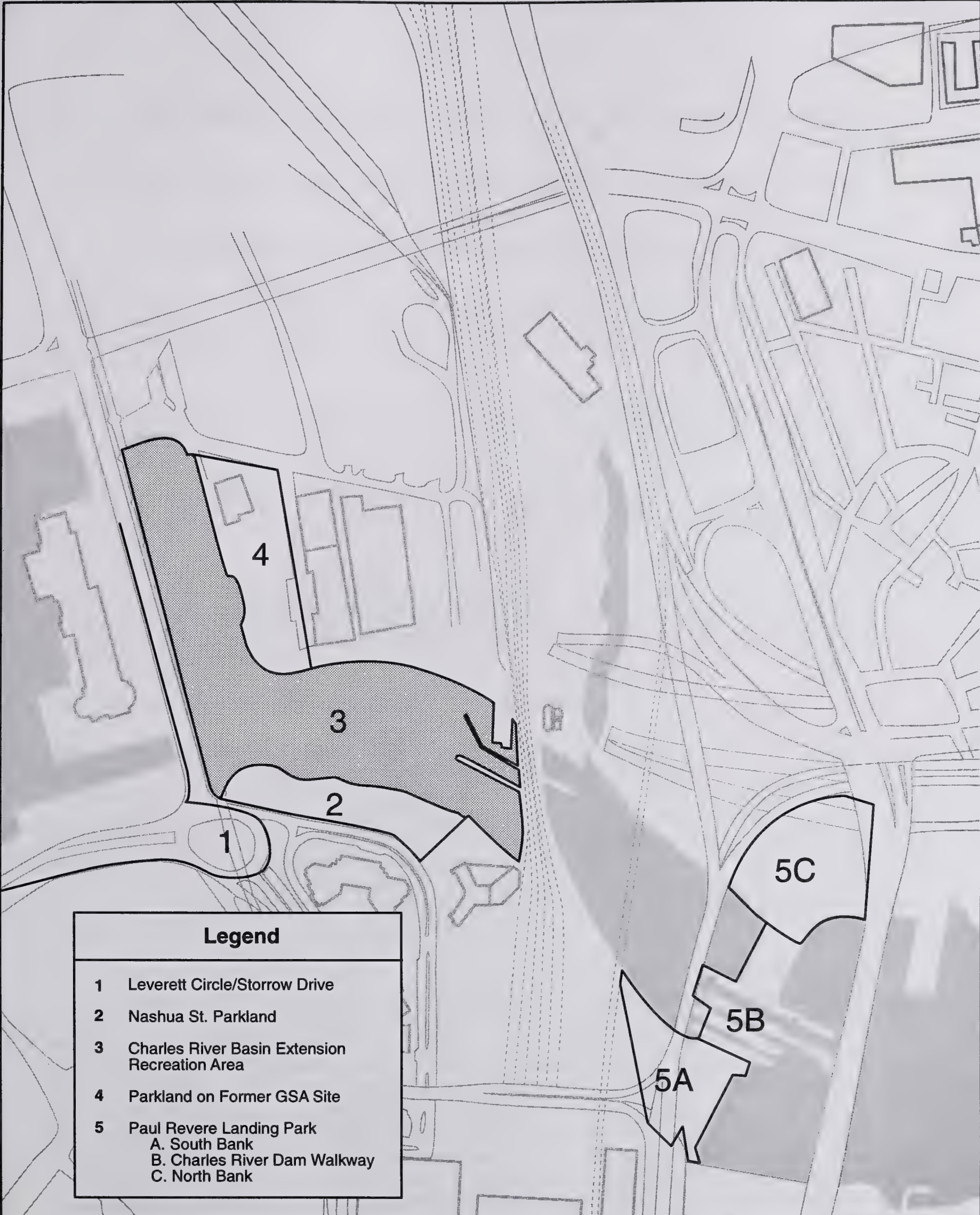
MHD has coordinated with the National Park Service regarding development of the Project since its inception, and has discussed this Draft Section 4(f) Evaluation with NPS. In addition, MHD has worked with NPS to facilitate visitor access via the Central Artery to the U.S.S. Constitution and other NPS facilities in the Charlestown Navy Yard and on the Freedom Trail in downtown Boston. These facilities are not affected by the Charles River crossing alternatives. MHD will continue to work with NPS during the process leading to the FSEIS to address concerns regarding the C-L ramp.

Historic and archaeological resources protected by Section 4(f) are the subject of ongoing regular meetings with the Massachusetts Historical Commission (the State Historic Preservation Officer) and Boston Landmarks Commission pursuant to the Section 106 Memorandum of Agreement. MHD has met weekly with these agencies and with the Cambridge Historical Commission to discuss the inventory of historic and archaeological resources potentially affected by the Charles River crossing alternatives, the effect of the alternatives on the resources, and measures to minimize harm.

3 PARKLANDS

The MDC is the regional agency which owns and manages the Charles River Basin, the old and new Charles River dams and navigation locks, and various land and water parcels associated with the Charles River Reservation. Five MDC parkland parcels are identified as Section 4(f) resources in the Area North of Causeway Street: Leverett Circle/Storrow Drive (part of the Charles River Esplanade); Nashua Street parkland and Spaulding walkway; Charles River Basin Extension Recreation Area; parkland at the former GSA site, where the MDC central services facility is located; and Paul Revere Landing Park, north and south bank portions (see Figure 1).

All alternatives for the Charles River crossing use land in Paul Revere Landing Park and the Leverett Circle portion of the Charles River Reservation, and all alternatives result in visual and noise impacts on the three other MDC parcels. The MDC park properties and impacts to them are described below individually; however, since these properties are intended to function in the future as a system, measures to minimize harm are discussed as a system in a single section following a summary of impacts to this system as a whole.



Legend

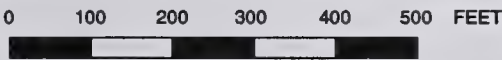
- 1 Leverett Circle/Storrow Drive
- 2 Nashua St. Parkland
- 3 Charles River Basin Extension Recreation Area
- 4 Parkland on Former GSA Site
- 5 Paul Revere Landing Park
 - A. South Bank
 - B. Charles River Dam Walkway
 - C. North Bank

FIGURE

1

**Section 4(f) Parkland Resources In
Lower Charles River Basin**
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



Use of the BHCC athletic field and jogging track by the general public renders it eligible for protection under Section 4(f).

All comparisons relate to the Scheme Z, except where one new alternative is explicitly compared to another.

3.1 Scheme Z And New Design Alternatives Considered In The 1993 DSEIS/R

Scheme Z includes two five-lane long-span bridges and one six-lane, medium-span, double-deck bridge over the Charles River, a two-way viaduct behind North Station connecting to Leverett Circle, and an interchange on the north bank of the river consisting of six nested loop ramps up to 105 feet high and tangent to the river's edge.

Alternative 8.1D Mod 5 has a single 10-lane long-span bridge, a three-lane river tunnel with a ventilation building on each side of the river, and a single loop ramp 35 to 40 feet high and 180 feet from the river's edge.

The Reduced River-Tunnel Alternative has a single 12-lane long-span bridge, a two-lane river tunnel with a ventilation building on each side of the river, and two loop ramps 35 to 40 feet high and 140 feet from the river's edge.

The Non-River-Tunnel Alternative has a 10-lane long-span bridge, a four-lane, medium-span, single-deck bridge with the same profile as the mainline bridge, no river tunnel, a ventilation building for land-based tunnels south of the river, and three ramps merging to two loop ramps 35 to 40 feet high and set back 140 feet from the river's edge.

3.2 Leverett Circle/Storrow Drive (Charles River Esplanade)

Description Of Section 4(f) Property. The Leverett Circle/Storrow Drive intersection is an area of approximately 1 acre lying within the southeastern boundary of the historic Charles River Reservation, a 1,000-acre public parkland including the Charles River and land on both sides of the river between the old Charles River dam (O'Brien Highway) and Watertown to the west. The Boston portion of the Reservation lying between Storrow Drive and the Charles River is called the Esplanade. The portion of the Esplanade park near Leverett Circle is heavily used and contains a pedestrian/bicycle path, a swimming pool, a wading pool, a baseball field, a football/soccer field, a tot-lot, and, closest to the Project area, two tennis courts. An historic building at the MDC dam currently housing a State Police station, and a parking area are located adjacent to Leverett Circle.

Although Storrow Drive was developed as a riverside parkway within the Charles River Reservation, its terminus at Leverett Circle has been modified over the years to accommodate heavy general traffic volumes. Leverett Circle is a landscaped traffic rotary at the intersection of Storrow Drive, O'Brien Highway, Nashua Street, Lomasney Way, Martha Road, and the approach ramps to the Central Artery (see Figure 2). The Green Line Science Park Line light rail transit station owned by the MBTA is located on an elevated structure that bisects the Circle. Two pedestrian bridges over Storrow Drive and Leverett Circle link the station with the Charles River Park private housing development and the Charles River Esplanade riverside park. Pedestrian access to the approximately 28,000-square-foot grassy area within the Circle is not available as it would be unsafe to cross the heavily travelled roadway that surrounds it. Peak hour traffic volumes on Storrow Drive, Nashua Street, and O'Brien Highway that feed into Leverett Circle are among the highest in the Central Business District. A westbound two-lane underpass at Leverett Circle carries traffic from I-93 and the Tobin Bridge to Storrow Drive, and two

surface lanes run between the underpass and the Esplanade. Eastbound, there are four surface lanes on Storrow Drive to provide traffic storage capacity at the Leverett Circle traffic signal. The south sidewalk and planting strip along Storrow Drive runs roughly parallel to the Esplanade but separated from it by eight lanes of traffic. It serves general pedestrian circulation and provides access to the Esplanade via overpasses used by pedestrians and bicyclists. There are opportunities for landscaping on both sides of the boat sections in all alternatives, and a new landscaping scheme for Storrow Drive and Leverett Circle is possible in all alternatives.

Farther south is another pedestrian overpass at Blossom Street linking Charles River Park over Storrow Drive and the Esplanade. This area lies within the Charles River historic district, which is addressed below under Historic Resources.

Impacts On Resources By Scheme Z And New Design Alternatives. Scheme Z and all of the new alternatives reconfigure the Leverett Circle intersection, with some areas of roadside landscaping converted to pavement and other areas converted from pavement to landscaping. After reconfiguration, there is a net decrease in parkway landscaping in all alternatives. In addition, an area of MHD land next to the intersection is landscaped and added to the property. The alternatives differ in land areas affected as follows:

Alternatives	Landscaping To Pavement (acres)	Pavement To Landscaping (acres)	Net Decrease (acres)	Additional Land Added (acres)
Scheme Z	0.44	0.13	0.31	0.27
8.1D Mod 5	0.30	0.12	0.18	0.10
Reduced River-Tunnel	0.55	0.08	0.47	0.12
Non-River-Tunnel	0.46	0.13	0.33	0.15

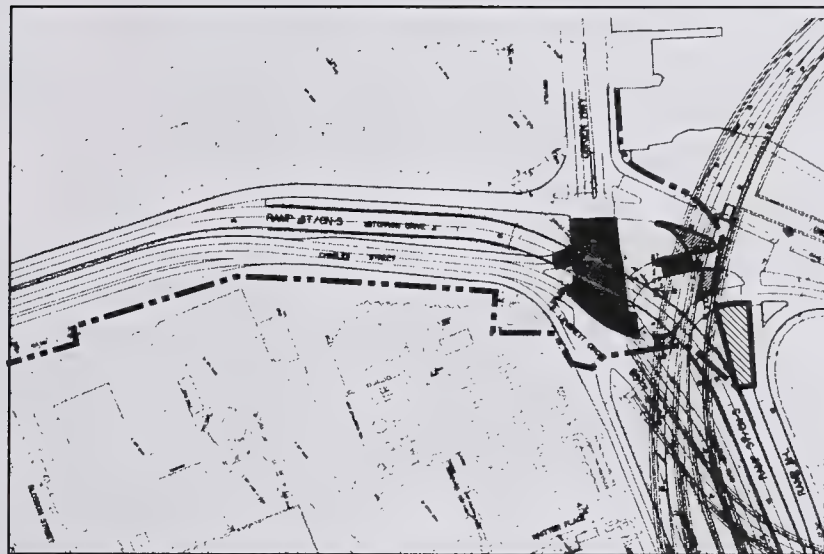
These changes alter the appearance of Leverett Circle and reconfigure the intersection and adjacent landscaping by removing the grass, shrubs, and trees within the Circle. Scheme Z, the Reduced River-Tunnel Alternative, and the Non-River-Tunnel Alternative appear similar in this area from the pedestrian's point of view, as all have eastbound underpasses located next to the existing westbound underpass, and thus require the widening of Storrow Drive on the side opposite the Esplanade. Although the eastbound underpass of the Reduced River-Tunnel crosses under the westbound underpass, while the underpasses are parallel in the Non-River-Tunnel, both alternatives have similar boat sections leading to the underpass. (Provision of a storage lane for left turns at Leverett Circle similarly shifts the eastbound boat section Scheme Z to the west, making it similar to these new alternatives.) The current appearance of the area is changed less in Alternative 8.1D Mod 5, which does not have an eastbound boat section and underpass; however, in this alternative this portion of Storrow Drive would be noticeably more congested, particularly during peak hours when heavy commuter volumes use this roadway. Storrow Drive cannot currently be crossed at grade in this area, so the widening in any of the alternatives has no effect on access to the Esplanade from the south sidewalk and the MBTA station. (Pedestrian bridges will be reconstructed in place.) None of the alternatives directly affects the adjacent Esplanade, as the existing westbound curbline next to the Esplanade is unchanged in all alternatives.

Noise modeling indicates that all three new alternatives result in marginal noise increases at the pedestrian overpass at Leverett Circle. Increases over Scheme Z are 2 dBA for Alternative 8.1D Mod 5, 2 to 3 dBA for the Reduced River-Tunnel Alternative, and 2 to 4 dBA in the Non-River-Tunnel Alternative.

Legend	
	Landscape to Pavement
	Pavement to Landscape
	Landscaped Area Added to Property
	Property Line



Scheme Z



Alternative 8.1D Mod 5



Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative





(Increases of 3 dBA are not perceptible by most people.) Total noise in the year 2010 at this busy intersection is 74 to 76 dBA, compared to 70 to 73 dBA today. Modeling results at locations in the Charles River Park apartment complex west of the intersection and farther from the roadway are more indicative of noise levels within the Esplanade. At these residential receptors, noise increases by 1 to 2 dBA in Alternative 8.1D Mod 5, and noise is lower in the Reduced River-Tunnel and Non-River-Tunnel Alternatives by 1 to 2 dBA; these changes are not perceptible by most people. (These results are presented in Section 4.4, Noise and Vibration.)

Air quality at Leverett Circle is worse than the Scheme Z in Alternative 8.1D Mod 5. One-hour CO concentrations increase in the year 2010 from 10.4 ppm to 11.7 ppm, and 8-hour concentrations increase from 6.2 to 7.0 ppm. Air quality is improved in the Reduced River-Tunnel and Non-River-Tunnel Alternatives. One-hour concentrations in the year 2010 decrease from 10.4 to 9.2 and 9.7 ppm, respectively, with these new alternatives, and 8-hour concentrations decrease from 6.2 to 5.5 and 5.8 ppm, respectively. The Non-River-Tunnel results in the larger decline in CO concentration in each case. (Refer to Section 4.3, Air Quality, for a discussion of these results.)

During construction, Scheme Z affects traffic in the Leverett Circle intersection and requires the reconstruction of pedestrian overpasses providing access to the Esplanade at Blossom Street and at Leverett Circle (via the Green Line Science Park Station). Construction is staged to maintain one of these pedestrian overpasses at all times. There is no direct construction period impact on the Esplanade park or temporary use of land from the Esplanade playground. All of the alternatives to Scheme Z likewise require staged reconstruction of pedestrian overpasses. None of these alternatives has direct impacts on the Esplanade park or temporarily uses land from the Esplanade playground.

Avoidance Alternatives. As discussed in the 1991 Section 4(f) Evaluation, connection of highway facilities to Storrow Drive is a principal objective of the Central Artery/Tunnel Project. Therefore, changes in the Leverett Circle intersection cannot be avoided. Alternative 8.1D Mod 5 changes the intersection to a lesser extent than the other alternatives, but consequently does not result in acceptable traffic conditions at the intersection. Additional design refinements currently being studied (described in Section 2.6.1) would refine the Leverett Circle intersection in Alternative 8.1D Mod 5; these refinements would increase the modification of Storrow Drive to a level similar to the other alternatives and would also require demolition of the historic Registry building (100 Nashua Street), a 4(f) resource.

3.3 Charles River Basin Extension Recreation Area

Description Of The Section 4(f) Resource. A portion of the Charles River below the old MDC dam, specifically the portion between the old dam and the MBTA railroad bridge, was designated by the MDC in 1990 as a water recreation area to be developed for active recreational boating uses. This water recreation area is administered by the MDC as a part of the Charles River Reservation, and is also referred to as the "new Charles River Basin upstream area."

This section of the river is part of the extended Charles River Basin which resulted from construction of the new MDC dam in 1978. The new MDC dam replaced the old dam at Science Park which was no longer able to contain major flood events.

The MDC manages the Basin extension and the new dam for multiple purposes including navigation, flood control, water quality protection, and fisheries restoration. The locks at the new dam serve substantial numbers of recreational, and some commercial, boats passing between Boston Harbor and the Charles River.

The MDC's designation of the upstream portion of the Basin extension, between the old dam and the railroad bridge (see Figure 1 for boundaries), for park and recreation purposes reflects changes in this river area since the approved 1985 FEIS/R, and planning considerations supporting significant recreational activity in the near-term future. Recreational boaters have access into this area: (1) through the twin bascule railroad bridge, which is raised for passing boats on weekdays when commuter railroad service is frequent, and left in an open position on weekends; and (2) through twin bascule bridges at the O'Brien Highway at the old dam which are also operated to allow boat passage.

Between the old dam and the railroad bridge, there is an expanse of open water suitable for recreational boating without interference with boats passing between the dams. While not as wide as it is upstream along the Esplanade, the river in this area is consistently 350 to 450 feet wide and over 1,150 feet long from dam to railroad bridge. Recreational boating in this area is planned by the MDC to be similar to the active recreational uses that have taken place for the past 75 years on the Charles River above the old dam. The MDC master plan proposes a dock facility at the former GSA parcel for canoes and paddle boats which would use this section of the river.

Impacts On Resources By Scheme Z And New Design Alternatives. Scheme Z has no river tunnel and thus avoids direct use of this portion of the Charles River. This area is adversely affected, however, by the views and noise of its six densely nested loop ramps on the north bank, rising to 105 feet in height, extending to within 45 feet of the granite wall bounding the river; the double-deck Storrow connector bridge located 150 feet downstream from this portion of the river also has visual impacts. No shadow impacts extend this far upstream, however. The 1991 Section 4(f) Evaluation concluded that visual impacts adversely affect the Charles River Basin Extension Recreation Area but do not constitute constructive use of this urban recreational resource. It was noted in the 1991 Final Section 4(f) Evaluation that large-scale highway ramps and bridges are major elements in views from the river. While perhaps tolerable in an urban setting, these impacts are typical of those which occasioned numerous public comments and resulted in the restudy of Scheme Z, leading to the three new alternatives studied in this DSEIS/R and in this Section 4(f) Evaluation.

The new alternatives substantially reduce visual impacts by reducing the number and height of loop ramps on the north bank of the river and increasing their setback from the river. Noise is marginally reduced by the greater distance to highway structures and by the use of land-based and, in some alternatives, river tunnels, for a portion of the traffic which crosses the river on viaduct in Scheme Z. (See Section 4.4, Noise and Vibration.)

In Alternative 8.1D Mod 5, there is a single loop ramp 35 to 40 feet high and 180 feet from the bank of the river. The highway bridge is 305 feet downstream, beyond the railroad bridge. An above-ground ventilation structure with eight exhaust-air discharge stacks is located 100 feet from the south riverbank, near the corner of the Nashua Street park parcel.

In the Reduced River-Tunnel Alternative, a pair of 35 to 40-foot high loop ramps is set back 140 feet from the north bank of the river. The highway bridge is 290 feet downstream, beyond the railroad bridge. A below-ground ventilation structure with four exhaust-air discharge stacks is located approximately 560 feet south of the riverbank and has no direct effect.

Construction period impacts are substantial in Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative. These alternatives require construction of a river tunnel, which is highly disruptive, for a period of 2 to 3 years. Construction involves placement of caisson-supported sheet pile barriers, dredging between these barriers, placement of prefabricated tunnel tube sections, and covering the immersed tubes. Major pieces of construction equipment such as cranes and dredges are placed on barges in this portion

of the river. This work is be staged to allow navigation between the old MDC dam and the bascule railroad bridge. On the north bank of the river there is a graving basin for fabrication of tube sections. Recreational boats are able to pass through this segment of the river during construction operations, but boats are not be permitted to remain near the construction operations and the setting is not suitable for water-based recreation during tunnel construction (see Section 5.1.2).

The Non-River-Tunnel Alternative avoids the direct impact resulting from tunnel construction under the Charles River associated with the other two new alternatives. Two 35- to 40-foot high loop ramps (having merged from three ramps well north of the river) are set back 140 feet from the north bank of the river. A single-deck Storrow Drive connector bridge is located 170 feet downstream, beyond the railroad bridge, but computer-generated perspective studies indicate that this bridge would be a visual improvement over the double-deck bridge in the Scheme Z (see Figures 3 and 4). A below-ground ventilation structure with four exhaust-air discharge stacks is located approximately 350 feet south of the riverbank and has no direct effect.

Scheme Z and the Non-River-Tunnel Alternative have no construction impact on the Charles River Basin Extension Recreation Area.

Avoidance Alternatives. Scheme Z and the Non-River-Tunnel Alternative avoid any use of the resource. In the two alternatives with river tunnels, it is impossible to avoid the Charles River Basin Extension Recreation Area because it lies directly between Leverett Circle and the Tobin Bridge, which the tunnel must connect. Additional design refinements to the Reduced River-Tunnel Alternative, currently being studied, see Section 2.6.2 of this DSEIS/R, have the potential to relocate the river tunnel downstream of the railroad crossing and thus avoid the Charles River Basin Extension Recreation Area. Conclusions regarding these design refinements will be presented in the FSEIS/R.

3.4 Nashua Street Park/Spaulding Walkway

Description Of Section 4(f) Property. Pursuant to the Chapter 91 License for construction of the new Suffolk County Jail, the State Division of Capital Planning and Operations transferred to the MDC a riverfront parcel of approximately 100,000 square feet, adjacent to Leverett Circle and the relocated Nashua Street. The new land acquisition extends the Charles River Esplanade approximately 800 feet to the east of the O'Brien Highway. Completion of park improvements depends in part on the relocation of an existing helistop, which under the existing terms of the Chapter 91 license must be relocated no later than December 31, 1994. This parcel has not yet been developed, and there is no current park use of the parcel.

Adjacent to the Nashua Street parcel is a wooden walkway 12 feet wide and extending 210 feet along the Charles River on a seawall to the edge of the privately owned Spaulding Rehabilitation Hospital property. Under a joint agreement with the MDC and Spaulding Hospital, the MBTA constructed the wooden walkway on the seawall behind Spaulding Hospital and conveyed the walkway to the MDC. Spaulding Hospital retained access rights and is to construct a pile-supported pier on the side of the walkway facing the river. (This future pier is not subject to Section 4(f).)

The Spaulding walkway will connect a future path in the Nashua Street parkland parcel with a concrete walkway constructed by the MBTA along the railroad tracks leading to the moveable-span railroad trestle or bascule bridge. These elements form links in a future pedestrian walkway system in the Charles River Basin Extension Area. The deck is currently well used in good weather, primarily by patients and visitors at Spaulding Hospital. When the Nashua Street parcel is developed as a park, the MDC-owned

walkway will be integrated with its pedestrian circulation and proposed uses as an extension of the Esplanade; accordingly, the Nashua Street parcel and the walkway are treated together in this analysis.

Although specific design and programming has not been completed, the Nashua Street parcel will function in a manner similar to those other portions of the Charles River Esplanade with comparable depth between the river and bordering streets (typically 120 feet). Views of the river and pedestrian connections along the river are key attributes. Likely activities at the Nashua Street park include the extension of the Esplanade path system for walking, jogging, roller-skating, and bicycling; passive activities (sitting on provided benches or grass, sunbathing and picnicking); and informal sports such as games of catch with frisbee, baseball/softball, and soccer ball. The Spaulding Walkway will continue to be used as today and as part of the extended path system.

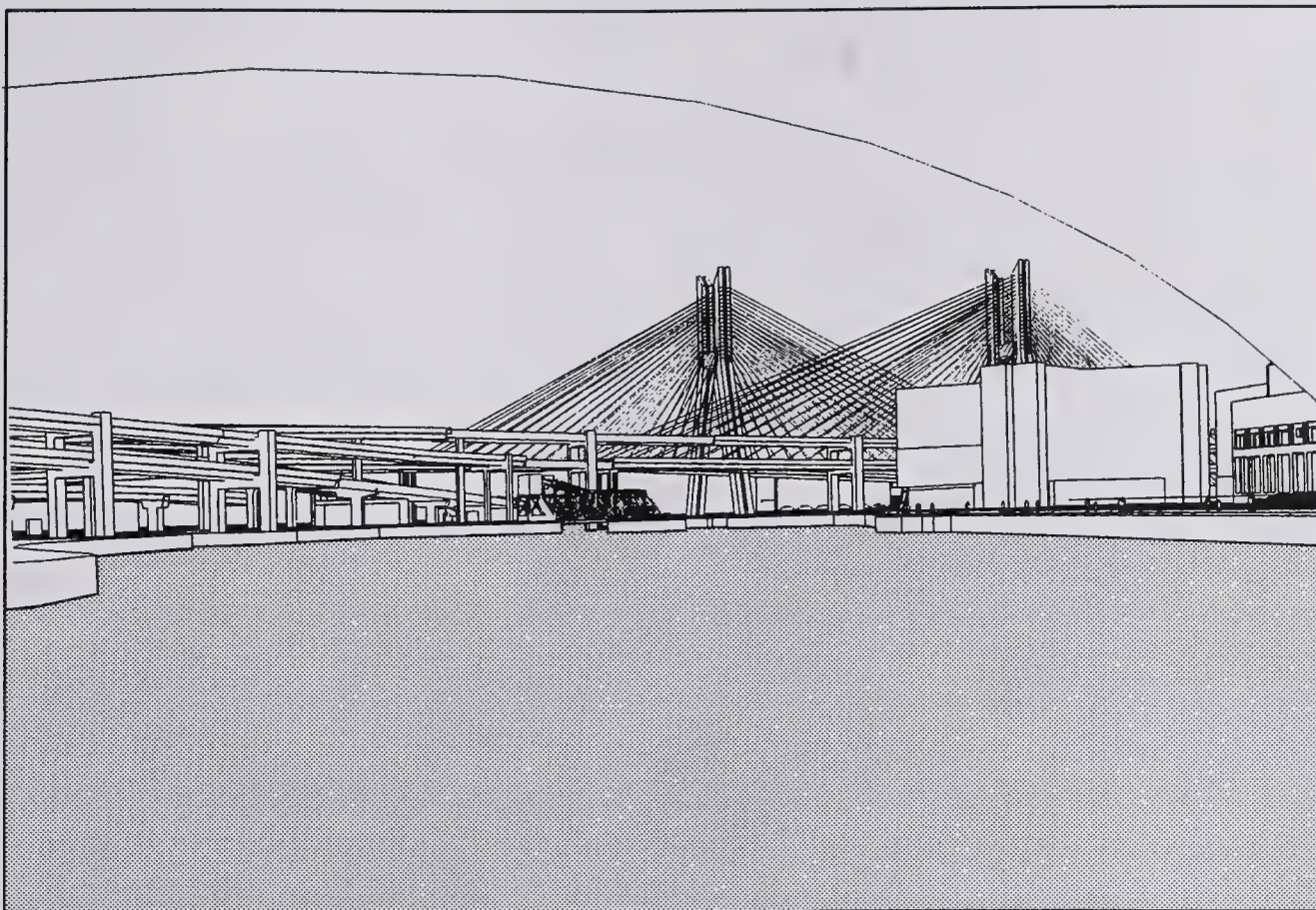
The MDC master plan proposes a small boat landing along the edge of the parcel. The master plan also proposes a free-standing pedestrian overpass of the MBTA North Station platforms, connecting the Spaulding Walkway to a riverbank downstream. This is an alternative to a future pedestrian overpass required by the MBTA's Chapter 91 license to be constructed as part of a potential air rights garage development of uncertain schedule.

Impacts On Resources By Scheme Z And New Design Alternatives. In Scheme Z, this area is adversely affected by the views of and noise from the six densely nested loop ramps on the north bank of the river, rising to 105 feet in height, directly across the river 430 feet from the downstream end of the park. The double-deck Storrow connector bridge located 360 feet downstream from the Nashua Street parcel (195 feet from the end of the Spaulding walkway), together with mainline bridges of different profile beyond, also have visual impacts and obstruct downstream views from these locations. No shadow impacts extend this far upstream, however. The 1991 Section 4(f) Evaluation concluded that noise and visual impacts adversely affect the Nashua Street park and Spaulding Walkway but do not constitute constructive use of these urban park resources, but are serious impacts.

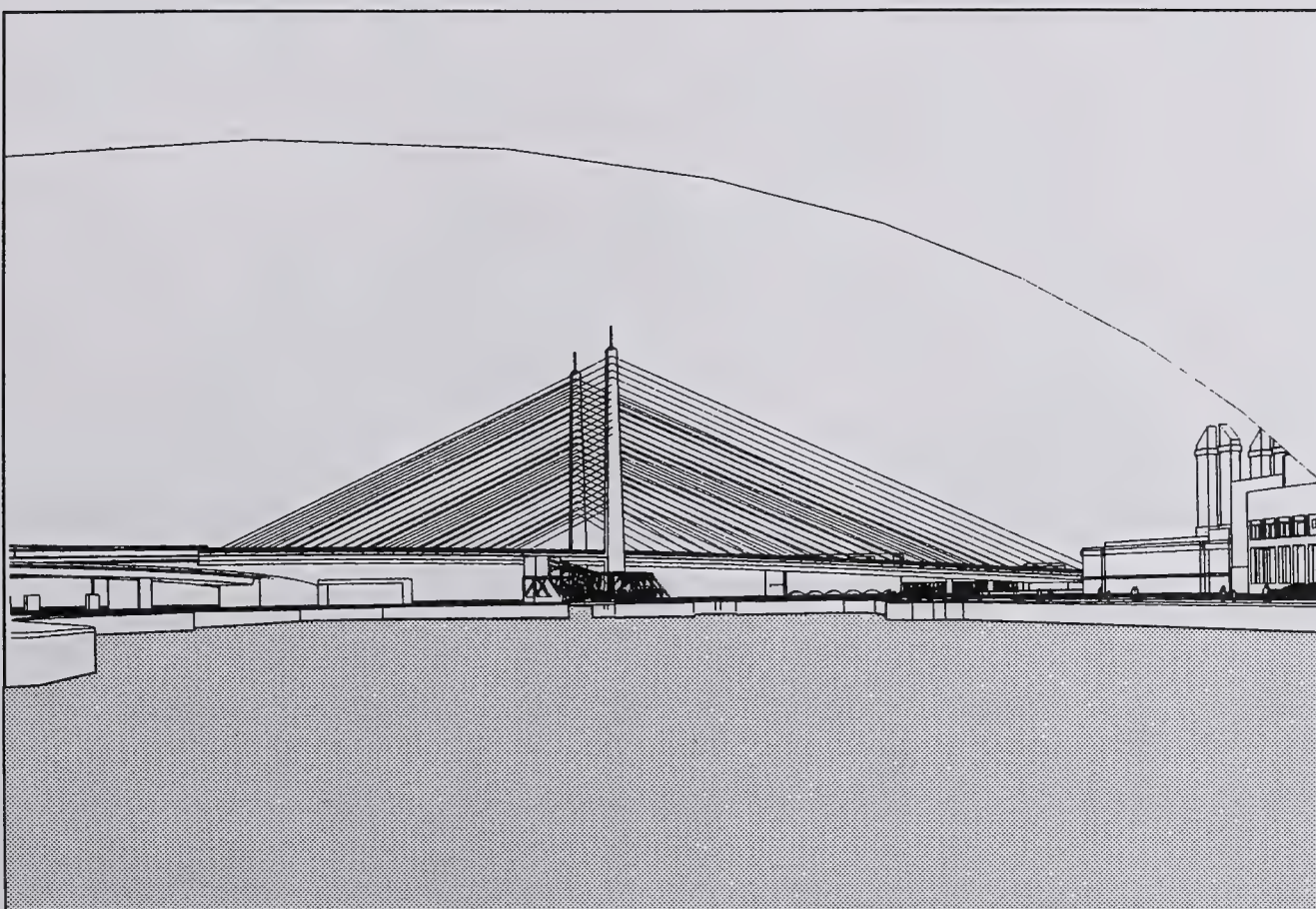
The new alternatives substantially improve the visual setting by reducing the number and height of loop ramps on the north bank of the river and increasing their setback from the river. Noise at the Spaulding Walkway is marginally reduced by 1 to 3 dBA because of the greater distance to highway structures and by the use of land-based, and, in two alternatives, by the use of river tunnels for a portion of the traffic which crosses the river on viaduct in Scheme Z.

In Alternative 8.1D Mod 5, there is a single loop ramp 35 to 40 feet high and set back farther from the north bank of the river than in Scheme Z, increasing its distance to 585 feet from the downstream end of the Nashua Street park. A single 10-lane bridge is located 495 feet from the Nashua Street parcel (320 feet from the end of the Spaulding walkway). An above-ground ventilation building with eight exhaust-air discharge stacks is located 100 feet from the corner of the existing park parcel, and may have adverse visual and shadow effects. The three lane river tunnel and a ventilation duct are located under this parcel, and there is permanent subsurface use of 0.52 acre of the property (see Figure 5). Small tunnel appurtenances such as an emergency egress stair might need to be sited within the park, requiring minimal surface use of the property.

In the Reduced River-Tunnel Alternative, a pair of 35 to 40-foot high loop ramps with similar profiles is set back from the north bank of the river, increasing their distance to 540 feet from the downstream end of the Nashua Street park. This alternative's single 12-lane bridge is 480 feet from Nashua Street parcel (305 feet from the end of the Spaulding walkway). A below-ground ventilation structure with four exhaust air discharge stacks is located approximately 570 feet south of the park and would have little or no effect on the park. A two-lane river tunnel is located under this parcel, and there is permanent



Scheme Z



Alternative 8.1D Mod 5

FIGURE

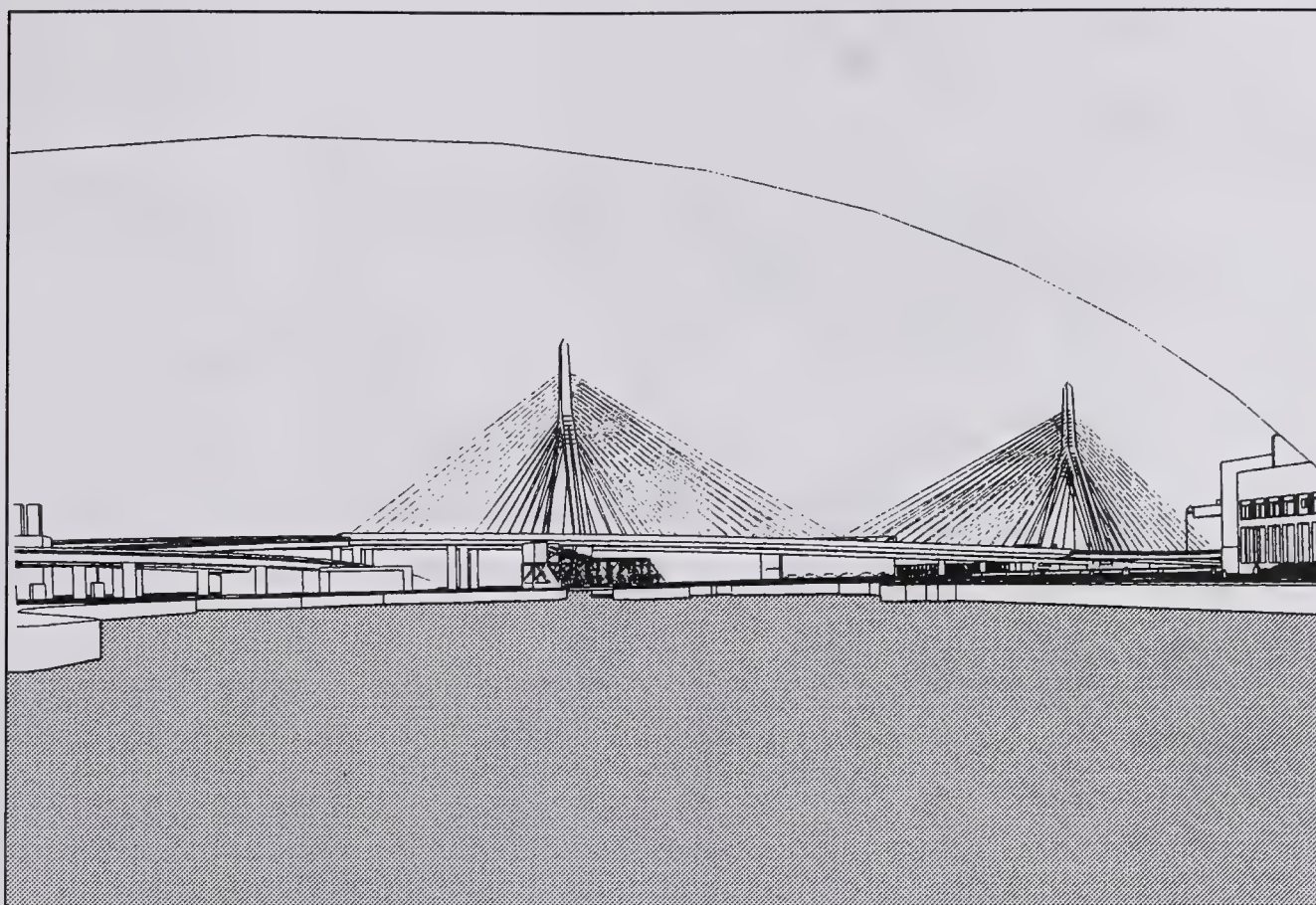
3

View Of Charles River Basin Extension
From Old MDC Dam: Scheme Z And
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R

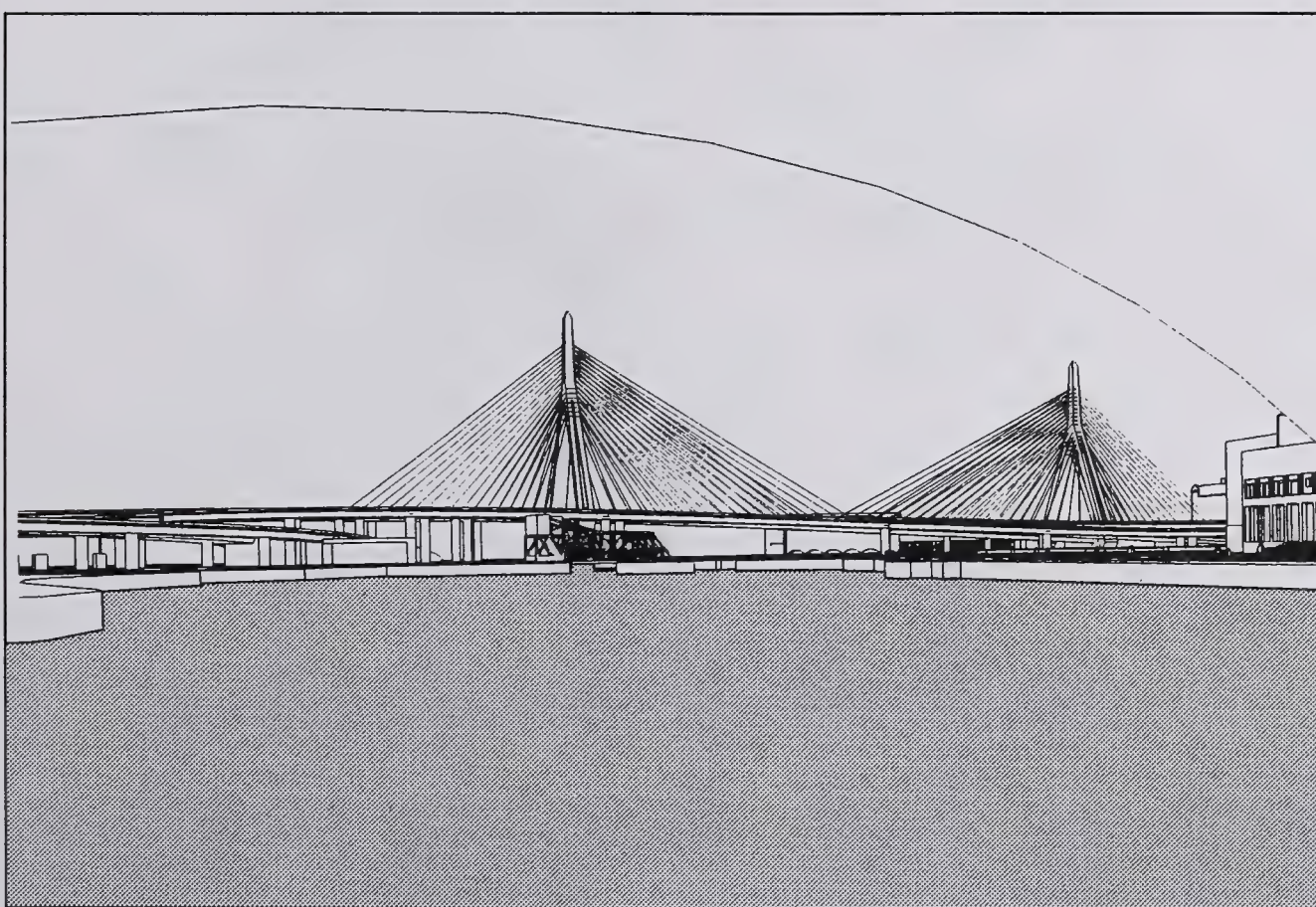
MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT







Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

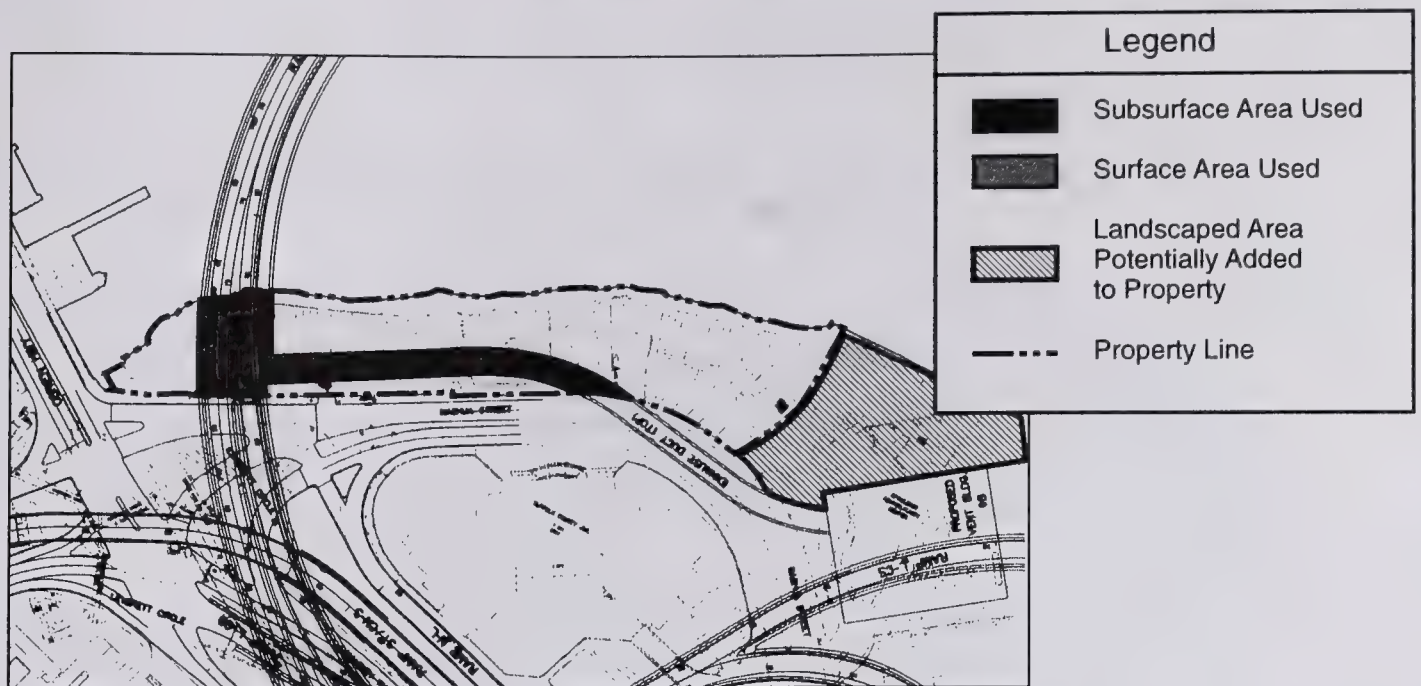
FIGURE

4

View Of Charles River Basin Extension
From Old MDC Dam: Reduced River-Tunnel
And Non-River-Tunnel Alternatives
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

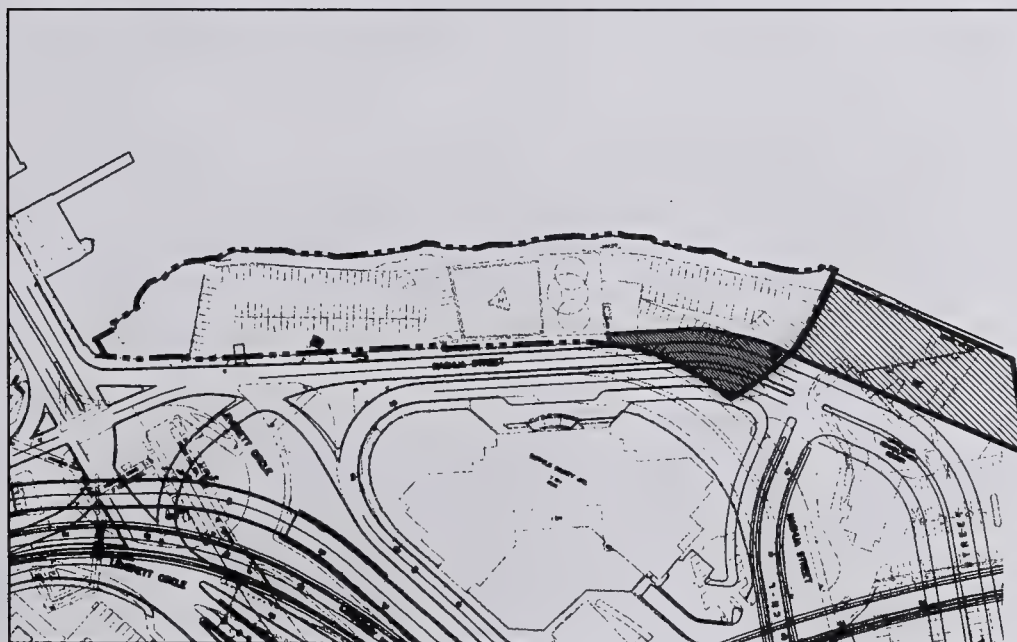




Alternative 8.1D Mod 5



Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

subsurface use of 0.19 acre of the property. Small tunnel appurtenances such as an emergency egress stair might need to be sited within the park, requiring minimal surface use of the property.

In the Non-River-Tunnel Alternative, a pair of 35 to 40-foot high loop ramps with similar profiles (after having merged from three ramps well north of the river), is set back from the north bank of the river, increasing their distance to 540 feet from the Nashua Street park. A single-deck Storrow connector bridge is located 360 feet downstream from the Nashua Street parcel (190 feet from the end of the Spaulding walkway). Computer generated perspective studies indicate that this single deck bridge has substantially less visual impact than Scheme Z's double-deck bridge because of the new alternative's lower profile; (see Figure 6 and 7). Overall, this visual setting is substantially improved compared to Scheme Z, whose high, dense loop ramps and double-deck bridge would dominate views. In the Non-River-Tunnel Alternative, Nashua Street is realigned, requiring the reconfiguration of the eastern end of the parcel. A corner of the existing Nashua Street parcel comprising 0.12 acre is used for the realigned street. A below-ground ventilation structure with four exhaust air discharge stacks is located approximately 380 feet south of the park and has little or no effect on the park.

Construction period impacts are greatest in Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative. These alternatives require use of the entire parcel during construction of a river tunnel, which would be highly disruptive, for a period of two to three years, delaying the development of the Nashua Street park for the entire construction period. (See discussion under Charles River Basin Extension Recreation Area, above.) The Non-River-Tunnel Alternative affects only the easternmost end of the 800-foot long parcel for periods of a few months during construction of the realignment of Nashua Street. Scheme Z has no construction impact on the parcel.

Summary: By removing most of Scheme Z's visually dominant loop ramps and its double-deck Storrow connector bridge with their attendant noise impacts, all new alternatives substantially improve the quality of the Nashua Street park for its planned uses compared to Scheme Z. The Non-River-Tunnel Alternative reconfigures a corner of the property and expands the park. Against this long term reduction in harm must be weighed the considerable construction period impacts of the Reduced River-Tunnel Alternative and Alternative 8.1D Mod 5, which require heavy tunnel construction occupying all of the parcel for 2 to 3 years and delaying any park development for 7 years. In the Non-River-Tunnel Alternative, there is no tunnel construction and the parcel could be developed as parkland prior to mainline construction, as is the case in Scheme Z; the park could later be extended with relatively little disruption after the realignment of Nashua Street.

Avoidance Alternatives. Scheme Z avoids all direct use of the parcel but has long-term visual and noise impacts. The Reduced River-Tunnel Alternative and Alternative 8.1D Mod 5 require the subsurface use of the parcel. The Non-River-Tunnel Alternative has a northbound off-ramp to Nashua Street whose geometry requires the realignment of the street into a corner of the parcel. Design variations are being pursued to completely avoid the parcel in this alternative by realigning the northbound off-ramp.

In the two alternatives with river tunnels, it is impossible to avoid the parcel because it lies directly between Leverett Circle and the Tobin Bridge, which the tunnel must connect. Additional design refinements to the Reduced River-Tunnel Alternative currently being studied, have the potential to relocate the river tunnel downstream of the railroad crossing and thus avoid the Nashua Street parcel (see Section 2.6.2 of this DSEIS/R). Conclusions regarding these design refinements will be presented in the FSEIS/R.

3.5 Parkland At The Former GSA Site

Description Of The Section 4(f) Property. In 1989, the MDC acquired a parcel of land of approximately 4 acres from the U.S. General Services Administration (GSA) at the northwest bank of the Charles River, opposite the old Charles River dam. The Cambridge/Boston line bisects the property. Half of the parcel currently is occupied by a parking lot and buildings of the MDC central services facility; the remainder is grass covered. There is no current park use of the parcel, except for the MDC maintenance facility. Master planning and programming is underway, and the GSA parkland will function in a manner similar to those other portions of waterfront parkland in the Esplanade system with comparable width (approximately 200 feet). Key attributes are views of the river, the Green Line Viaduct and the old MDC dam, and path connections along the north bank of the river between East Cambridge and Charlestown. Activities at the GSA park will include the extension of the Cambridge side of the Esplanade path system, and active and passive uses. The MDC master plan proposes a docking facility for small boating activities such as canoes and paddleboats.

Impacts On Resources By Scheme Z And New Design Alternatives. Scheme Z has visual and noise impacts in this area due to its six densely nested loop ramps rising to 105 feet in height at a distance of 300 feet from the GSA parcel and intruding to within 50 feet of the river, thus affecting downstream views. In the new alternatives, the loop ramps are reduced in height and number and their distance from the GSA parcel is increased.

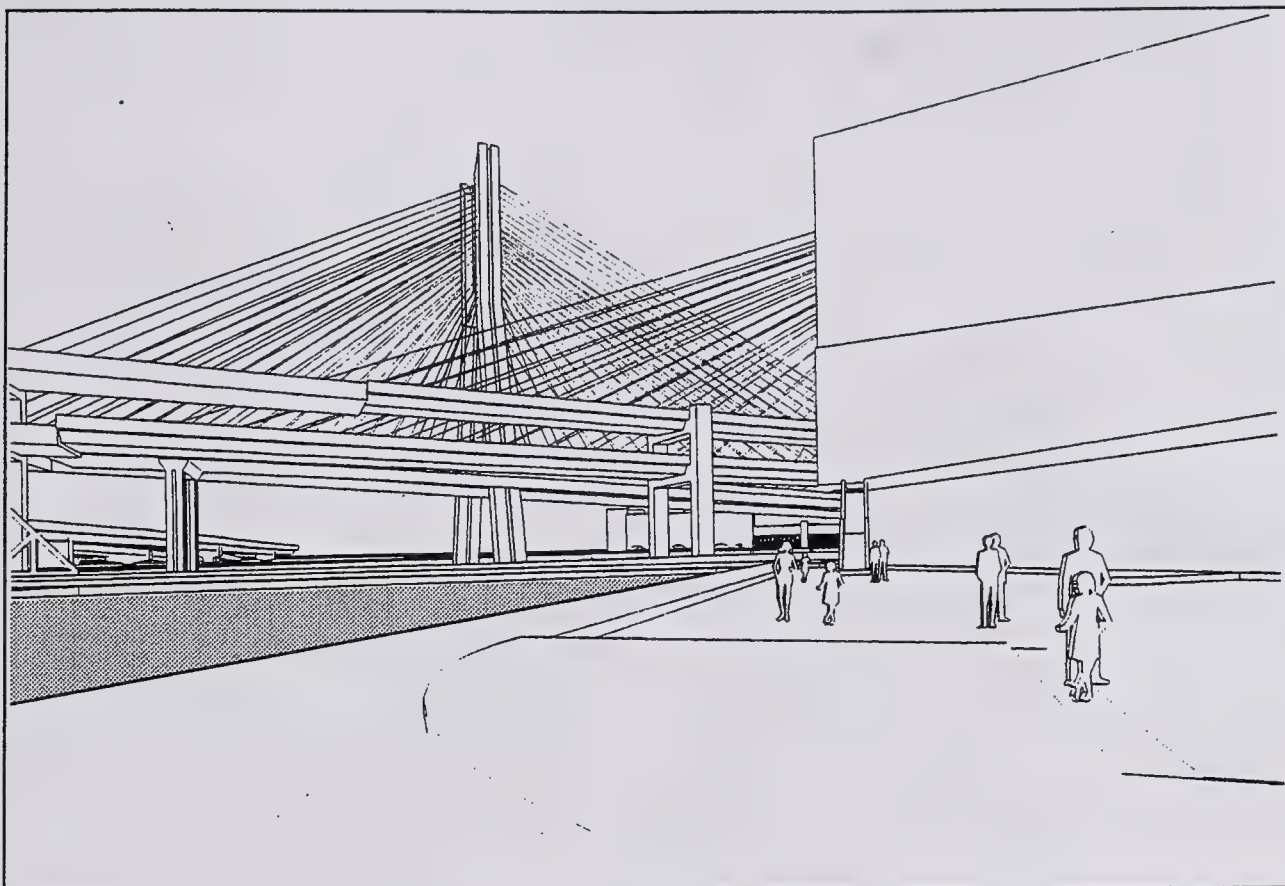
Alternative 8.1D Mod 5 has a single loop ramp 35 to 40 feet high and located 370 feet from the GSA parcel and 180 feet from the Charles River.

The Reduced River-Tunnel Alternative has a pair of loop ramps 35 to 40 feet high with similar profiles and simple supporting structures located 380 feet from the GSA parcel and 135 feet from the Charles River. A ventilation building located near BSG inside the loop ramp 900 feet away has no effect on the GSA parcel.

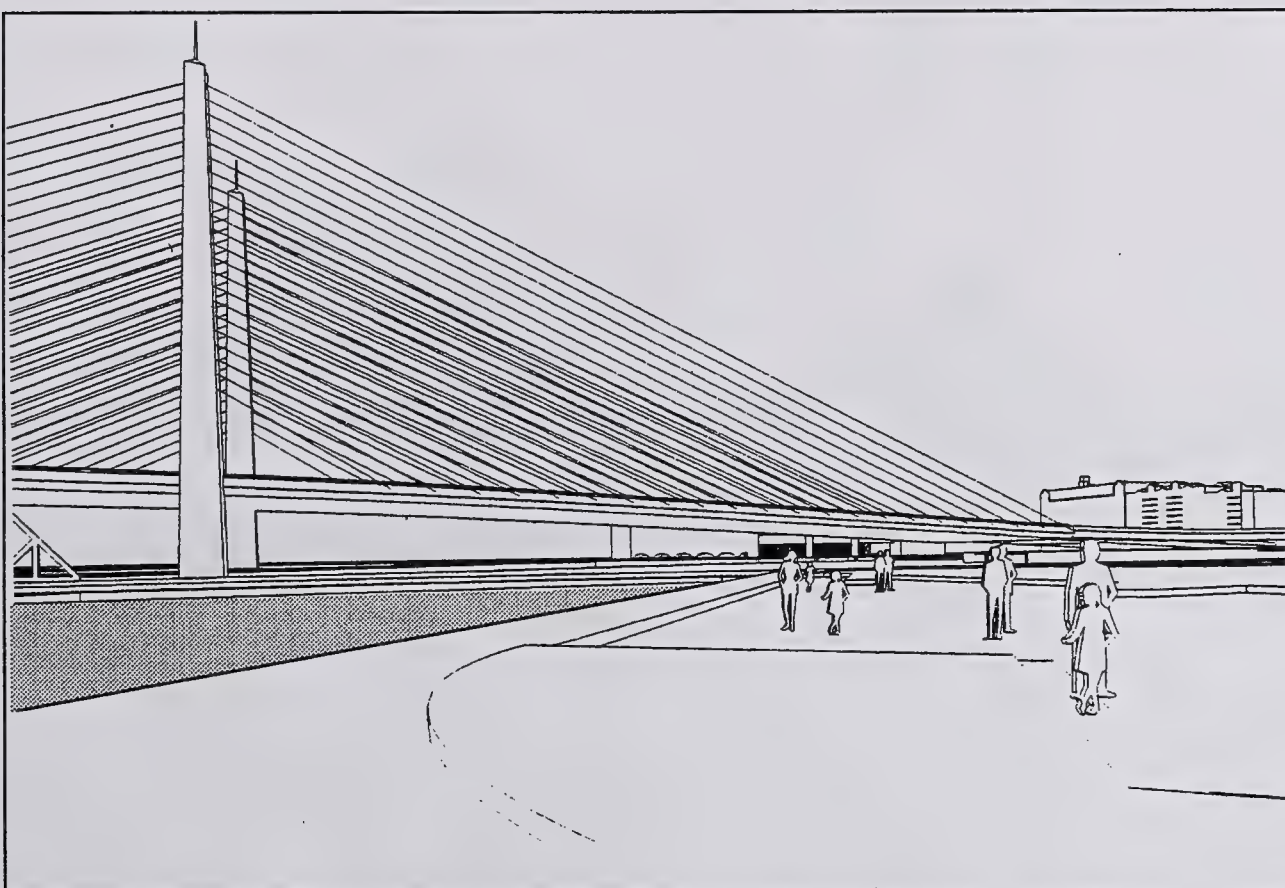
The Non-River-Tunnel Alternative has three ramps merging to a pair of side-by-side loop ramps with common profiles 35 to 40 feet high, and simple supporting structures located 355 feet from the GSA parcel and 135 feet from the Charles River; a single-deck highway bridge is located 940 feet downstream. Visual impact from the former GSA site is essentially the same as the Reduced River-Tunnel Alternative and similar to Alternative 8.1D Mod 5.

Construction period impacts occur in the two alternatives with river tunnels. In Alternative 8.1D Mod 5, the river tunnel is located 15 feet from the southeast corner of the GSA parcel. This alternative requires construction of a river tunnel, which is highly disruptive to the recreational use of the Charles River and which might disrupt use of the park on the GSA parcel for a period of 2 to 3 years. Major pieces of construction equipment such as cranes and dredges are placed on barges in this portion of the river immediately offshore the GSA park, and in Alternative 8.1D Mod 5, a corner of the property extending 30 feet into the park is required for tunnel construction. On the north bank of the river, there is a graving basin for fabrication of tube sections; the location of these facilities has not yet been determined, but there is a potential for construction noise, dust, and disruption to the GSA parcel due to the graving basin.

Impacts of the Reduced River-Tunnel Alternative are similar, except that the tunnel alignment in this alternative is 215 feet from the corner of the GSA park and no park property would be required for construction. The Non-River-Tunnel Alternative has no construction impact on the park on the former GSA parcel. Scheme Z has no construction impact on this park.



Scheme Z



Alternative 8.1D Mod 5

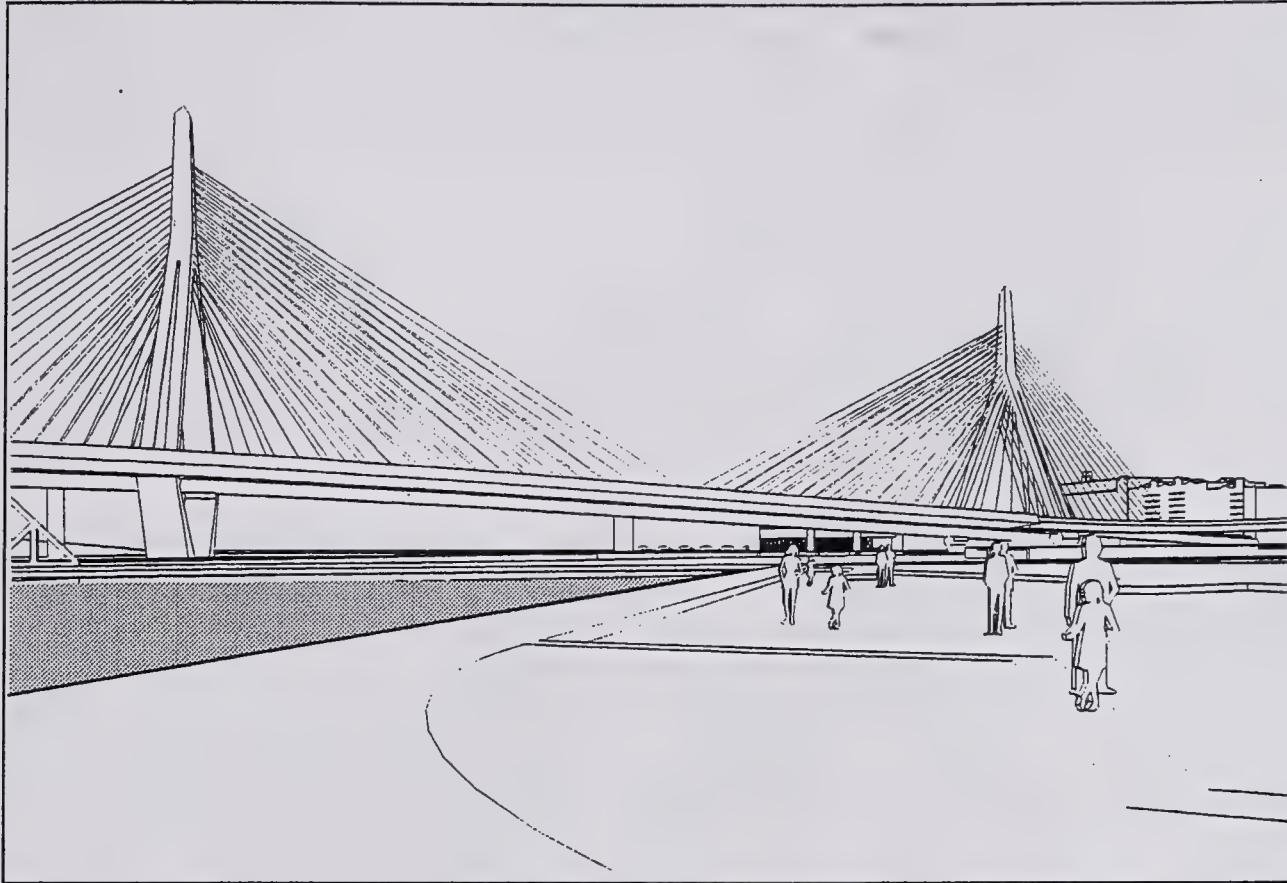
FIGURE

6

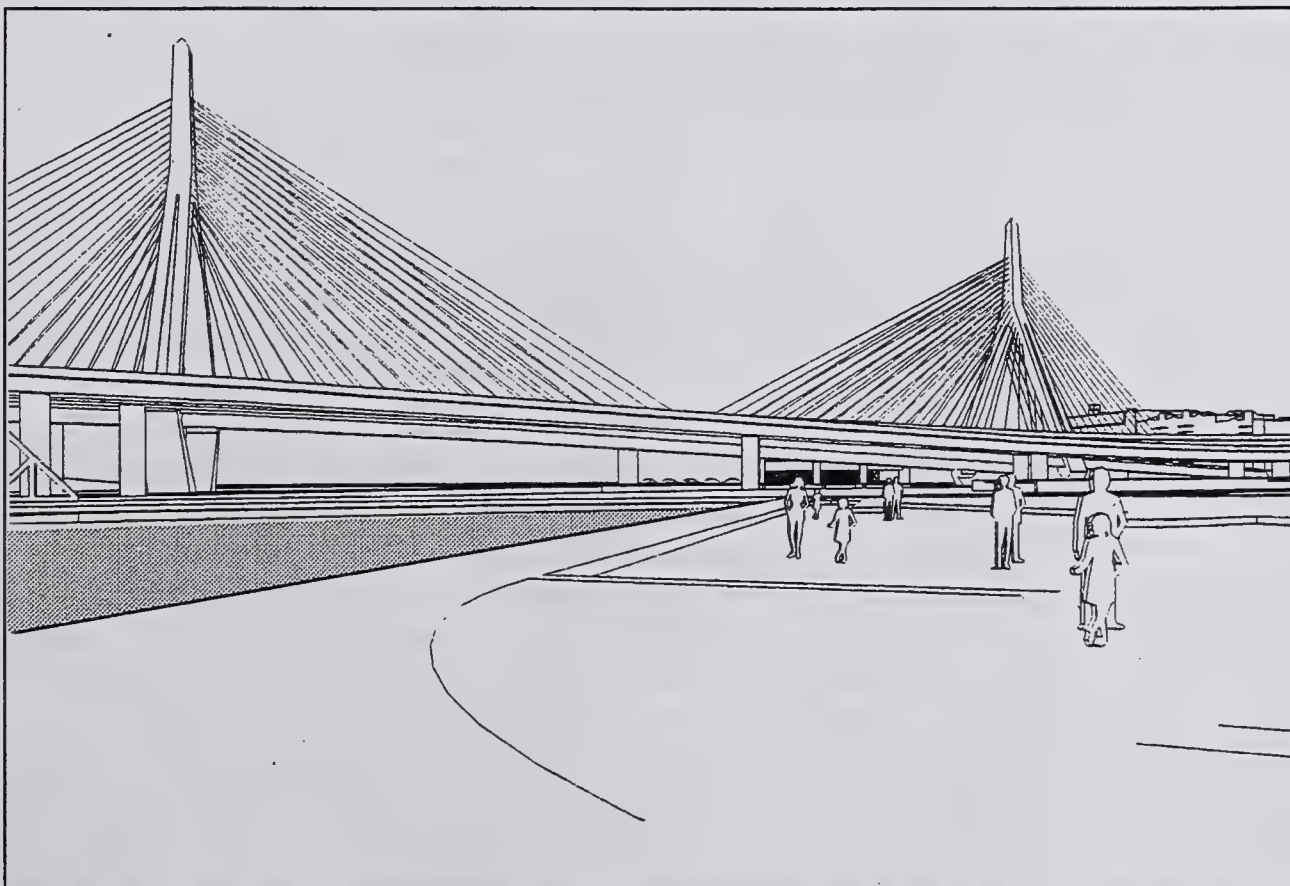
View From Downstream End Of
Nashua Street Park: Scheme Z And
Alternative 8.1D Mod 5
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT





Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

FIGURE

7

View From Downstream End Of Nashua
Street Park: Reduced River-Tunnel
And Non-River-Tunnel Alternatives
Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT



Summary: All new alternatives reduce visual impacts on the park on the former GSA parcel; all are a major improvement over Scheme Z. The Reduced River-Tunnel Alternative has proximity impacts on the park during construction, though no land is temporarily used. Alternative 8.1D Mod 5 temporarily uses a 30-foot width of land for construction of its river tunnel. The Non-River-Tunnel Alternative, like Scheme Z, avoids all construction impacts.

3.6 Paul Revere Landing Park

Description Of Section 4(f) Property The MDC's Paul Revere Landing Park (approximately 6.5 acres) is situated on both banks of the Charles River, linked by a walkway over the Charles River dam locks. The park was developed by the MDC in conjunction with the its construction of the new Charles River dam, completed in 1978.

South Bank. The approximately 3-acre south bank portion includes a riverside walkway, benches, four picnic tables, minimal landscaping, and a parking lot with approximately 105 spaces for vanpools and cars of MDC employees at the Harbor Patrol and the Charles River dam and pumping station. Most of the land is devoted to parking. The bottom of the superstructure of the existing Central Artery high-level truss bridge is approximately 50 feet above the mean high water level of the Charles River. The clearance above the park is slightly less, and the bridge visually dominates the park and casts permanent shadows on it. It is isolated from Causeway Street, and access to it is not marked by signs. MHD has easement rights of access in and adjacent to the MDC-owned park for maintenance and other purposes associated with the overhead highway structure. Despite the current constraints, the park is part of a well-used pedestrian crossing of the Charles River via the walkway across the locks of the dam.

In the future, the south bank portion of Paul Revere Landing Park is planned as an important node in the regional path system (i.e., a place where paths meet), providing an entrance to the riverfront open space system from Causeway Street and the North Station transportation facilities. Connecting paths will lead upstream, across the dam to the north bank, and under the North Washington Street bridge to the MDC North End park and the Boston Harborwalk.

The MDC master plan recommends removal of the current parking lot and addition of landscaping and amenities such as a fountain. Passive uses oriented to the river and the locks of the dam are proposed. The master plan also suggests an active use under the bridge, as consistent with public safety regulations.

Charles River Dam Walkway. Each day, approximately 500 pedestrians cross the Charles River dam between Charlestown and Causeway Street, according to the CANA project construction site manager, on a unique walkway over the lock gates. Additional pedestrian access over the dam is provided through an exhibition gallery along the east side of the dam building. The new Charles River dam was built in 1978 as a flood control facility, functionally replacing the old Charles River dam (at O'Brien Highway) farther upstream. It is located between the North Washington Street and Central Artery high-level bridges. The dam includes three locking facilities: two recreational locks, each 200 feet long and 25 feet wide for pleasure craft; and one larger lock, 300 feet long and 40 feet wide, for commercial vessels. In 1992, the annual number of locking of pleasure craft was approximately 27,000 vessels, reaching a peak flow estimated at 8,000 during the month of July. Annual commercial locking is far less frequent, and is estimated to be 60 vessels (approximately one every 6 days). Commercial vessels include oil, construction, and fireworks barges, the latter making their annual round trip through the lock on the Fourth of July for the celebration further upstream. A flood control pumping station is located on the north side of the dam, and the MDC Harbor Patrol facility is found on the south side. Within the pumping station is a parkland exhibit space with a 12-minute slide show on the Charles River.

North Bank. The 3.3-acre portion of the park on the north bank of the river was constructed in 1978 along with the Charles River dam. Abutting the park is a 0.3-acre area which formerly was part of the park and now is owned by MHD for construction of the CANA project, a separate undertaking. Some of this area previously was a part of the park. The remaining parkland is landscaped and includes lighting and walkways. The park provides a pedestrian connection between City Square in Charlestown and the walkway across the Charles River dam locks to Causeway Street. Most of the park is being temporarily used for construction of the CANA project. Prior to CANA construction, this portion of the park served for passive recreational uses, primarily walking and sitting with views of the river, and access to the walkway across the dam for jogging, bicycling, and walking. The park is fenced temporarily, and it closes each evening at 6:00 PM. Following CANA construction, this area will be reconfigured and landscaped for passive use in a manner similar to its previous state.

The CANA project provided for expansion of the park to mitigate construction impacts and to replace parkland taken by that project. This CANA mitigation and replacement land will expand the north bank portion of the park by 1.1 acres to a total of approximately 4.4 acres. As described in the CANA 4(f) Evaluation, park boundaries is extended to the west to include land under the existing I-93 bridge and then-existing ramps. The new Project bridges allow removal of the existing I-93 high-level bridge from this area of future parkland. A portion of the park will be improved by MHD in 1994 as part of the recent Massachusetts Chapter 91 license for construction of the temporary CANA loop ramps on this filled tideland. All of the three new alternatives expand the park upstream.

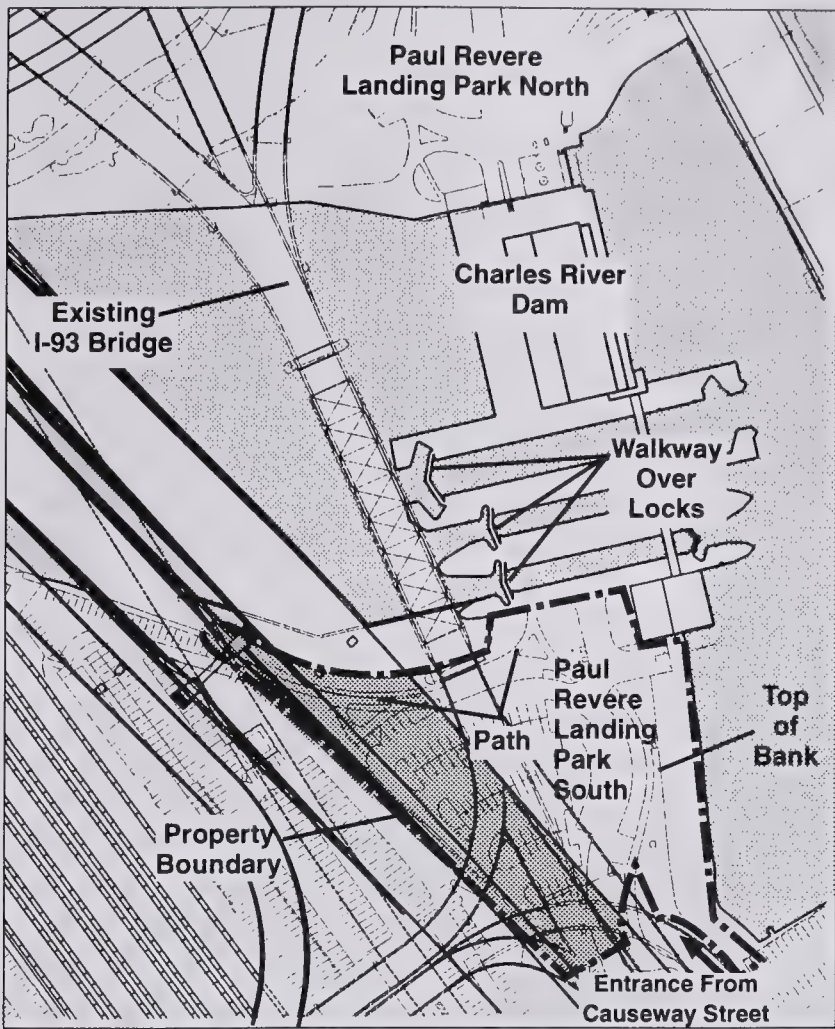
The future expanded north bank portion of the park is planned a major recreation area oriented to the river and dam and serving as both part of the Charles River open space system and as a major neighborhood park for the Charlestown community. This park will be a major node in the path system with connections upstream to the pedestrian overpass at the railroad crossing, two connections downstream under the North Washington Street bridge, to City Square, and to the walkway across the dam to Paul Revere Landing Park.

The MDC master plan includes both a large central "meadow" usable for informal sports, and a playground area along the park's north edge.

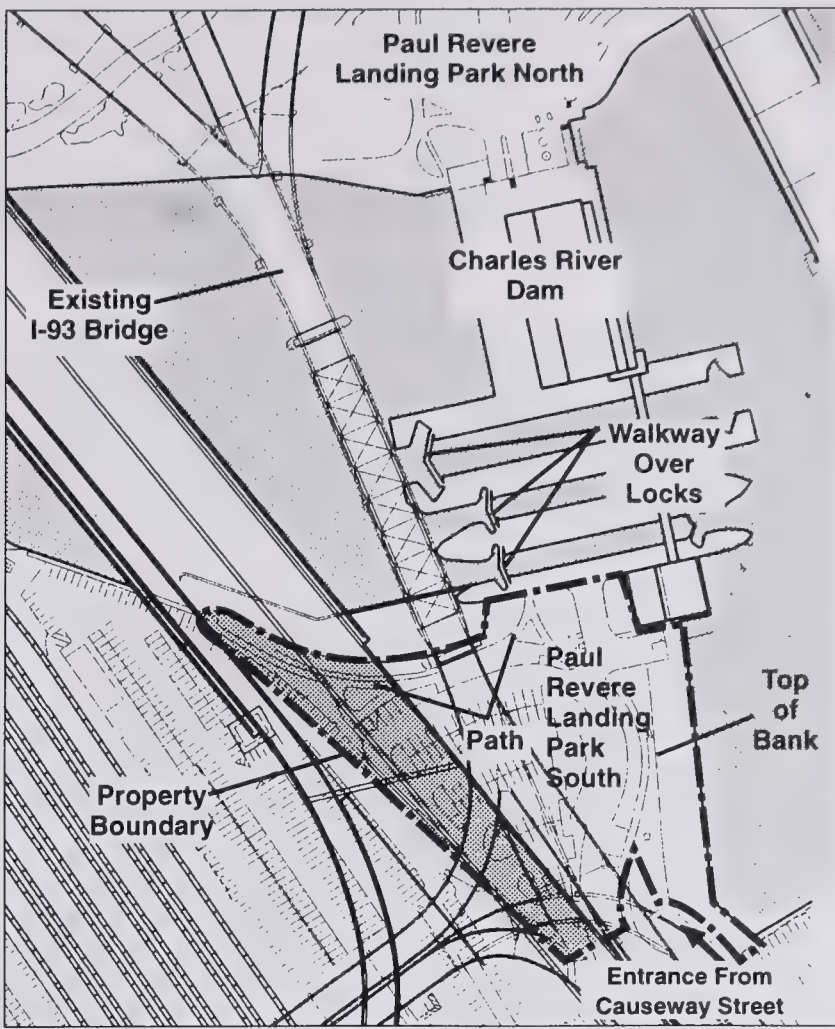
Impacts On Resources By Scheme Z And New Design Options Alternatives.

South Bank: All designs have a combination of benefits and impacts to Paul Revere Landing Park South: while removing the overhead viaducts that currently blight this park, the new mainline bridge occupies a portion of its 3 acres of land. Rising from a tunnel under Causeway Street in a boat section that ends near the southern end of the park, the northbound mainline in all alternatives is supported on retained fill to a point where the bridge structure begins 25 to 45 feet back from the top of the riverbank, or more, depending on final bridge design and mitigation in this area. The presence of heavy traffic separated from ground-level park users by a vertical wall requires mitigation in all designs. Because of the relatively low bridge profile, most of Paul Revere Landing Park South is free of shadows from 9:00 AM to 3:00 PM, except for the portion under the bridge decks. Noise is similar to Scheme Z in all alternatives (within 2 dBA).

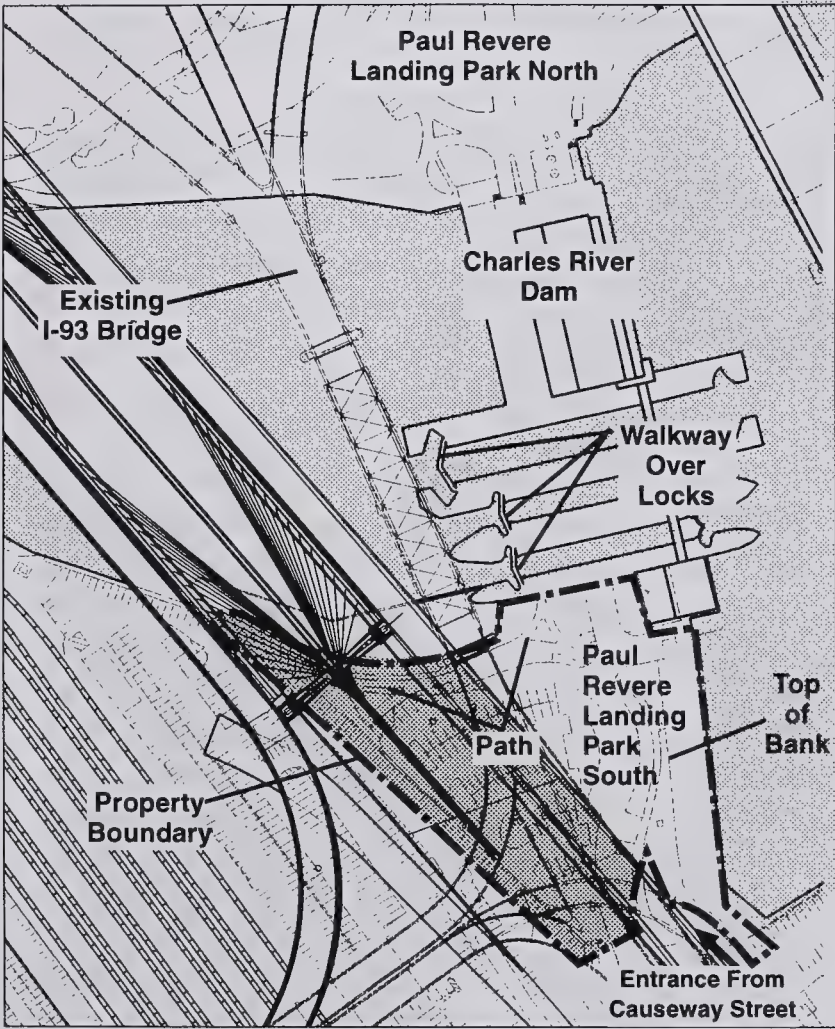
Scheme Z occupies approximately 0.61 acre of Paul Revere Landing Park South with its highway supported on retained fill as it rises from below grade to the mainline bridge that crosses the Charles River. Total aerial use in the south bank portion of the park is 0.35 acre, including the riverbank to the water line. The park area downstream of the bridge is roughly triangular, with a maximum dimension of approximately 195 feet at the corner of the dam, and this triangular area fulfills the planned functions of the park as a path connection and passive use area focused on the river and the dam (see Figure 8). Active use under the bridge is constrained by the relatively low bridge height ranging from 10.5 feet to



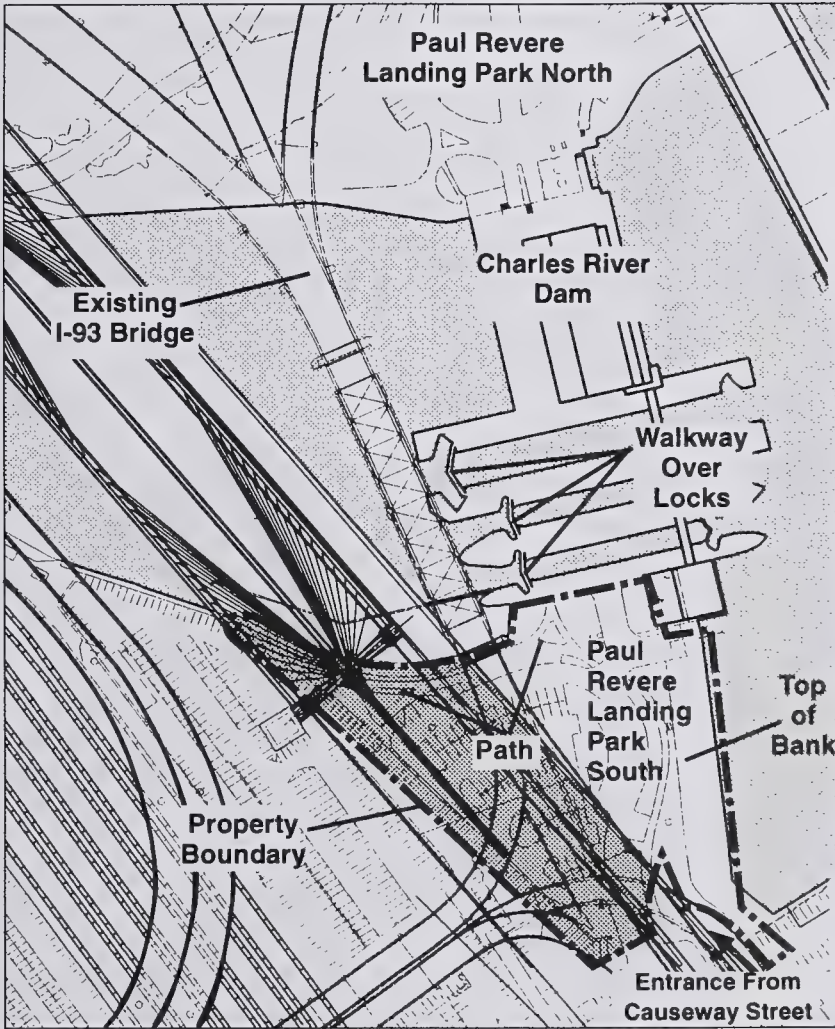
Scheme Z



Alternative 8.1D Mod 5



Reduced River-Tunnel Alternative



Non-River-Tunnel Alternative

20 feet above the path along the riverbank. The approach to the park is 73 feet wide at the Charles River Building and 56 feet wide from the retaining wall to the top of riverbank as one enters the park near Lovejoy Wharf.

All three new alternatives narrow the approach to the park property, between Causeway Street and Lovejoy Wharf, but there is little difference among the new alternatives and Scheme Z in the manner in which Paul Revere Landing Park South can be improved to serve as a major entry area to the park system as envisioned in the MDC master plan. All new alternatives significantly improve bridge aesthetics as viewed from the park. In all alternatives, the planned functions and uses reflected in the MDC master plan can be implemented successfully.

North of Lovejoy Wharf, Alternative 8.1D Mod 5 is approximately 20 feet narrower than Scheme Z as it enters Paul Revere Landing Park South owing to the relocation of one lane of northbound Central Artery traffic to the river tunnel. The portion of the park not used by the highway is roughly triangular, gaining width as the riverbank rapidly diverges from the highway; the park property reaches a maximum width of 225 feet near the dam. Total use of the south bank portion of the park south of the abutment wall is 0.44 acre. Total aerial use between the abutment wall and the river is 0.32 acre, including the riverbank to the water line (these figures are based on worst-case assumptions about the location of the abutment wall, which is dependent on the development of the bridge design). Functionally comparing Scheme Z and Alternative 8.1D Mod 5, the same type of park design and program could be accommodated, with a marginal benefit in Alternative 8.1D Mod 5 due to its slightly greater park area. Bridge design and the absence of supporting piers near the south riverbank make Alternative 8.1D Mod 5 aesthetically superior to Scheme Z, adding to the attractiveness of the park. As in Scheme Z, active use under the bridge would be constrained by the relatively low bridge height, ranging from 10.5 feet to 18 feet on the path along the Charles River.

Alternative 8.1D Mod 5's boat section includes an additional ramp element and flares to a greater width south of Lovejoy Wharf than that of Scheme Z, narrowing the pedestrian approach to the park to 63 feet wide at the historic Charles River Building; (this access way is not currently part of the MDC property). The width of the pedestrian approach from Causeway Street increases the visitor passes Lovejoy Wharf, and views open to the river on the right. The riverbank cuts in toward the highway just north of Lovejoy Wharf; in the area between the Wharf and the current MDC property Alternative 8.1D Mod 5 is narrower than Scheme Z, and the minimum width of this area, which would be added to the park, is 76 feet.

The Reduced River-Tunnel and Non-River-Tunnel Alternatives are identical at Paul Revere Landing Park South. Both are 30 to 38 feet narrower in the park than Scheme Z owing to their two-tower bridge design and to restoration of a northbound Central Artery on-ramp whose absence in Scheme Z was a major cause of concern. In both alternatives, the portion of the park not used by the highway is roughly triangular, gaining width as the riverbank rapidly diverges from the highway; the park property reaches a maximum width of 170 feet near the dam, which is adequate to create the type of plaza envisioned in the MDC master plan. Total use of the south bank portion of the park south of the abutment wall is 0.85 acre. Total aerial use between the abutment wall and the river is 0.41 acre, including the riverbank to the water line (these figures are based on worst-case assumptions about the location of the abutment wall, which is dependent on the further development of the bridge design). Bridge design and the location of fewer supporting piers near the riverbank make these alternatives aesthetically superior to Scheme Z, adding to the attractiveness of the park. As in Scheme Z, active use under the bridge is constrained by the relatively low bridge height, ranging from 9 feet to 18 feet on the path along the Charles River. Bridge shadows are broken by sunlight passing between the main bridge deck and the cantilevered lanes on the downstream side.

In both the Reduced River-Tunnel and Non-River-Tunnel Alternatives, the approach to the park property from Causeway Street is adequate for pedestrians and bicycles, two-way passage of official vehicles, and some landscaping. Owing to a wider boat section in these alternatives, the access way is narrower than in Scheme Z, 38 feet instead of 70 feet wide at the historic Charles River Building. As the visitor approaching from Causeway Street passes Lovejoy Wharf, views open to the river on the right. The riverbank cuts in toward the highway just north of Lovejoy wharf; this area between the wharf and the current MDC property, which is added to the park, is 25 feet wide at its narrowest point, functionally adequate for entry to the park but suggesting the need for some decking over the existing riprap bank to provide landscaping appropriate to the park entry as discussed in Measures to Minimize Harm, below.

In all new alternatives, as in Scheme Z, Paul Revere Landing Park South is occupied for several years by construction activities during erection of the Charles River crossing and demolition of the existing I-93 bridge. Pedestrian access to the walkway over the locks and official vehicular access to the dam are maintained except for brief interruptions for safety reasons.

Summary. Functionally comparing Scheme Z and the three new alternatives, the same type of design and programmed use is accommodated at Paul Revere Landing Park South. In all alternatives, there is adequate area to create within the park a successful landscaped plaza serving as a major entry to the park system. There are also major impacts in all alternatives due to the use of parkland, and the presence of heavy traffic separated from ground-level park uses by a vertical wall; although different in type from the current impacts of the existing overhead structure, these future impacts require carefully designed mitigation. While all three new alternatives have bridges which reduce overhead clearance on the riverfront path compared to Scheme Z, the bridges in these new alternatives are far superior aesthetically and thus contribute to the success of this park for which the bridge is the major backdrop. (In the new bridges, an architectural abutment wall is located based on a design criterion for headroom, e.g., 8 feet of overhead clearance. This wall could be moved farther from the river if the bridge deck is thinner than in the worst case design assumption, making the area under the bridge both higher and larger; lowering the existing ground would have the same benefit.) The greatest difference among the new alternatives is in the width of the approach from Causeway Street (on property not currently part of the park); the Reduced River-Tunnel and Non-River-Tunnel Alternative leave a narrower access way than Alternative 8.1D Mod 5. This access is nonetheless wide enough for unconstrained passage by pedestrians and bicycles, for two-way access for official vehicles, and for landscape treatment appropriate to the buildings of the bordering historic district. The approach area can be successful in any alternative if improved as described below under Measures to Minimize Harm.

Charles River Dam Walkway: The 1991 Section 4(f) Evaluation concluded that under Scheme Z, future air, noise, and vibration impacts on the dam are less than those existing, since its new bridges are farther away (140 to 375 feet as compared to the 55 to 120 feet for the existing bridge); the walkway is virtually free of bridge shadows, even in winter; and Scheme Z has no impact on the walkway except visually.

In the long term the new alternatives also have no impact on the walkway except visually. In this respect, all are superior to Scheme Z because of their superior bridge aesthetics. All new alternatives have bridges with the same aesthetically improved profile 25 to 50 feet above the river surface, and all have bridges in a similar location with respect to the walkway. In Alternative 8.1D Mod 5, the bridge is 160 feet upstream from the walkway at its closest point. In both the Reduced River-Tunnel and Non-River-Tunnel Alternatives, the bridge is 110 feet away at this point. These differences in distance do not substantially change the experience of walking across the locks in any of the new alternatives.

Construction impacts in all new alternatives are the same as for Scheme Z: that is, pedestrian access across the dam lock gates is temporarily interrupted on an intermittent basis for about 1 year, for safety

reasons, while the existing I-93 bridge, which is overhead, is dismantled and removed following construction of the new I-93 bridge.

North Bank: Scheme Z relocates the Charles River crossing significantly farther from the parkland than the existing I-93 bridge; this is also the case with all new alternatives. In so doing, Scheme Z permits the expansion of this part of Paul Revere Landing Park farther to the west than called for in the CANA Project Section 4(f) Evaluation (which adds 1.1 acres to the park, including 0.4 acre directly under the existing I-93 bridge). Under Scheme Z the total expansion is 2.5 acres, including the 1.1 acres required for the CANA project. In Scheme Z, there are residual visual impacts on this part of the park due to the three bridges crossing the river upstream, although these visual impacts are of less severity than views of the existing I-93 viaduct connections to the Tobin Bridge which currently border the park on two sides. There are also noise impacts in Scheme Z from the traffic on the viaducts and from the City Square intersection.

The new alternatives expand the park westward to approximately the same extent as Scheme Z, but they also widen the park to the north by realigning the Central Artery-to-Tobin Bridge loop ramp and by relocating the Central Artery local off-ramp from City Square to the Bunker Hill Community College property north of the Gilmore Bridge. This results in an increase in parkland at a location where it can be best used by the Charlestown community and regional park users. Noise at Paul Revere Landing Park North is essentially the same as Scheme Z (within 1 dBA). Air quality at nearby City Square is improved in all new alternatives. One-hour Carbon Monoxide concentrations in the year 2010 are reduced from 12.1 ppm in Scheme Z to 9.1 ppm in Alternative 8.1D Mod 5, and 8.7 ppm in the Reduced River-Tunnel and Non-River-Tunnel Alternatives (see Section 4.3, Air Quality, of this DSEIS/R).

In Alternative 8.1D Mod 5, the off-ramp to City Square is removed, allowing the park to expand 150 to 175 feet to the north as well as 350 feet upstream along the river; the total area of expansion is 4.1 acres. Views are improved by the new bridge design, and the closest highway ramp along the north edge of the park is a depressed boat section rather than a surface ramp, reducing noise and visual impact next to the area proposed in the MDC master plan as a playground.

The Reduced River-Tunnel Alternative is similar to Alternative 8.1D Mod 5, expanding the park both upstream by 285 feet, and to the north by 150 feet, and improving views. The closest ramp on the north side of the park is a boat section, and the total expansion of the park is 3.6 acres.

The Non-River-Tunnel Alternative also expands the park upstream by 350 feet and improves views to the same extent as the other alternatives. It expands the park to the north by 150 to 200 feet by eliminating the tunnel/boat connection of Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative. The closest ramp on the north side of the park is a boat section, and the total expansion of the park is 4.3 acres.

Summary: All alternatives extend this portion of the park to a greater extent than in Scheme Z, providing additional area for both informal sports activities in the central "meadow" and the potential playground envisioned in the MDC master plan. Visual impacts near the proposed playground are also improved. Of the new alternatives, the Non-River-Tunnel Alternative provides more expansion land than Alternative 8.1D Mod 5 followed by the Reduced River-Tunnel Alternative, and Scheme Z.

Avoidance Alternatives. As discussed in detail in the 1991 Section 4(f) Evaluation, it is not possible to avoid the Paul Revere Landing Park South property because of the highly constrained corridor available for the I-93 Charles River crossing. A design refinement to the Reduced-River-Tunnel and Non-River-Tunnel Alternatives described in Sections 2.6.2 and 2.6.3 proposes substituting a five-lane

northbound I-93 for the current four lanes plus two outside lanes. This refinement would reduce width in Paul Revere Landing Park South to an extent similar to Scheme Z. Conflicts with the Gilmore Bridge and MWRA pumping facility, bridge asymmetry, and other issues remain to be resolved, and are currently being studied; results will be reported in the FSEIS/R.

3.7 Overall Comparison Of Impacts On MDC 4(f) Parklands

The following section compares the Section 4(f) impacts on MDC parklands within the Area North of Causeway Street from the perspective of how each alternative affects this interrelated group of parklands as a system.

The three new alternatives all have the same goal with respect to parkland in this area of the Charles River: to facilitate the achievement of the MDC's long-range park objectives by reducing the major adverse proximity impacts of Scheme Z. This goal is achieved through designs which reduce the number and size of loop ramps on the north bank of the Charles River and which improve the aesthetics of the Charles River crossing, while minimizing other impacts to Section 4(f) resources.

The three new alternatives have the greatest improvement over Scheme Z at the three parks located upstream of the railroad crossing. Visual impacts are reduced in all three alternatives, and noise is improved in some locations. Differences among these alternatives as viewed from these parks are minimal (see Figures 3 and 5). Loop ramp configurations appear much the same from most vantage points in these parks. Alternative 8.1D Mod 5 has an above-ground ventilation building close to the Nashua Street park, while the Reduced River-Tunnel and Non-River-Tunnel Alternatives have smaller, below-ground ventilation buildings farther from the park. The separate Storrow Drive connector bridge in the Non-River-Tunnel Alternatives has a profile that is similar to the mainline bridge beyond so that the two bridges are much more visually harmonious than the bridges of Scheme Z, a substantial visual improvement. Although its second bridge will be perceptible as closer to these parks than the bridges of the other two new alternatives, the Non-River-Tunnel Alternative is much more similar to these new alternatives than it is to Scheme Z with its much higher double-deck bridge. The effect of the three new alternatives on park values and functions is essentially the same at the Nashua Street park/Spaulding Walkway, Charles River Basin Extension Recreation Area, and park on the former GSA parcel. As a result, these parklands are better able to fulfill a crucial role in creating an integrated park system in the Area North of Causeway Street, extending the Esplanade toward Paul Revere Landing Park.

The Reduced River-Tunnel Alternative and Alternative 8.1D Mod 5 have river tunnels which cause substantial construction disruption to the use of the river and the GSA parcel and delay improvement of the Nashua Street park for an extended period. The Non-River Tunnel Alternative uses 0.12 acre of the Nashua Street parcel for a realigned Nashua Street.

Leverett Circle is reconfigured in Scheme Z and in all three new alternatives. While these alternatives differ in the design of the intersection and in the details of changes to Storrow Drive, the Charles River Esplanade is not directly affected by any alternative. Mitigation is required since there is use of the MDC parkway and its roadside landscaping.

All the new alternatives expand Paul Revere Landing Park North substantially more than Scheme Z, more than doubling its size and improving its setting. The width and quality of the planned pedestrian connection between Paul Revere Landing Park North and the GSA parcel are dramatically improved in all new alternatives. The expansion of the park is greatest under the Non-River-Tunnel Alternative.

Table 1

SUMMARY OF SECTION 4(F) IMPACTS TO MDC PARKLAND

1991 Proposed Action	8.1D Mod 5	Reduced River Tunnel Alt.	Non-River Tunnel Alt.
Leverett Circle/Storrow Drive Uses 0.44 acres of parkway landscaping, removes 0.13 acres of pavement for net use of 0.31 acre. Adds 0.27 acres of new landscaped area to MDC property. No impact on playground or Esplanade walkways except noise, dust during construction.	Uses 0.30 acres of parkway landscaping, removes 0.12 acres of pavement for net use of 0.18 acre. Adds 0.10 acres of new landscaped area to MDC property. No impact on playground or Esplanade walkways except noise, dust during construction.	Uses 0.55 acres of parkway landscaping, removes 0.08 acres of pavement for net use of 0.47 acre. Adds 0.12 acres of new landscaped area to MDC property. No impact on playground or Esplanade walkways except noise, dust during construction.	Uses 0.46 acres of parkway landscaping, removes 0.13 acres of pavement for net use of 0.33 acre. Adds 0.15 acres of new landscaped area to MDC property.. No impact on playground or Esplanade walkways except noise, dust during construction.
Charles River Basin Extension Recreation Area Remains appropriate for recreational use; visual impacts from six loop ramps extending to 45' from river's north edge and downstream bridges. Double-deck bridge located 150' downstream. No construction impact.	Remains appropriate for recreational use; reduced visual impacts from single loop ramp set back 180' feet from north bank and by visually improved highway bridge located 305' downstream. Above ground vent building 100' from shore. Disrupted by tunnel construction for a period of 2 to 3 years.	Remains appropriate for recreational use; reduced visual impacts from double loop ramp set back 135' feet from north bank and by visually improved highway bridge located 290' downstream. Below ground vent building 550' from shore. Disrupted by tunnel construction for a period of 2 to 3 years.	Remains appropriate for recreational use; reduced visual impacts from double loop ramp set back 135' feet from north bank and by a visually improved single-deck bridge located 170' downstream. Below ground vent building 300' from shore. No construction impact.

Table 1, continued

1991 Proposed Action	8.1D Mod 5	Reduced River Tunnel Alt.	Non-River Tunnel Alt.
Nashua Street Parkland and Spaulding Walkway No use of land. Visual impact from six densely nested loop ramps, up to 105' high and 400' away. Double-deck bridge 350' downstream. Park improvement can begin immediately; little or no construction impact.	No permanent surface use of land; 0.52 acre subsurface easement. Potentially adds 0.85 acre of new landscaped area on Spaulding Hospital site. Reduced visual impact of single 40' loop ramp 585' away and improved bridge 495' downstream. Visual impact of ventilation building 100' from park. Park improvement delayed by tunnel construction using entire parcel (2-3 years).	No permanent surface use of land; 0.19 acre subsurface easement. Potentially adds 0.57 acre of new landscaped area on Spaulding Hospital site. Reduced visual impact of double 40' loop ramps 570' away, and visually improved bridge 480'. Below ground vent building 570' from park. Park improvement delayed by tunnel construction using entire parcel (2-3 years).	Reconfigures east end of parcel, using 0.12 acre. Potentially adds 0.57 acre on Spaulding site for net increase of 0.45 acre. Reduced visual impact of double 40' loop ramps 540' away, and visually improved single-deck bridge 360' downstream. Below-ground vent building 300' from park.. Park improvement can begin immediately on majority of property; some construction impact due to relocation of Nashua Street.
GSA Parcel Visual impact from bridges 900' away and loop ramps 300' away. Ramps high, dense. Park improvement can begin immediately; no construction impact.	Visual impact reduced; visually improved bridge 1100' away; single loop ramp 370' away. Ramp height reduced from 105' to 40'. Park improvement can begin immediately, but disruption will occur during river tunnel construction 15' away.	Visual impact reduced; visually improved bridge 1100' away; double loop ramp 380' away. Ramp height reduced from 105' to 40'. Park improvement can begin immediately; some disruption will occur during river tunnel construction but less than in 8.1D Mod 5, as tunnel is smaller and 215' away.	Visual impact greatly reduced; visually improved bridges 900' away; double loop ramp 355' away. Ramp height reduced from 105' to 40'. Park improvement can begin immediately; no construction impact.

Table 1, continued

1991 Proposed Action	8.1D Mod 5	Reduced River Tunnel Alt.	Non-River Tunnel Alt.
Paul Revere Landing Park: South Bank Uses 0.61 acre of parkland, aerial use of 0.37 acre. Park 195' wide at corner of dam. Approach to park is 73' wide at Charles R. Bldg; 56' wide at entry near Lovejoy Wharf. Clearance 10.5 to 20' under new bridge; can improve by lowering ground level. Park improved by removal of existing overhead structure and new bridge further from dam.	Uses 0.44 acre of parkland, aerial use of 0.32 acre. Park 225' wide at corner of dam. Approach to park is 63' wide at Charles R. Bldg; 76' wide at entry north of Lovejoy Wharf. Clearance 10.5 to 18' under new bridge; can improve by lowering ground level. Park improved by removal of existing overhead structure and new bridge further from dam.	Uses 0.85 acre of parkland, aerial use of 0.41 acre. Park 170' wide at corner of dam. Approach to park is 38' wide at Charles R. Bldg; 25' wide at entry north of Lovejoy Wharf; can be improved by extending decking from Lovejoy Wharf. Clearance 9 to 18' under new bridge; can improve by lowering ground level. Park improved by removal of existing overhead structure and new bridge further from dam.	Same as Reduced River Tunnel.
Dam Walkway Closest bridge 140' from walkway over locks; visual environment and relationship to banks improved.	Closest bridge 160' from walkway over locks; visual environment and relationship to banks improved.	Closest bridge 110' from walkway over locks; visual environment and relationship to banks improved.	Same as Reduced River Tunnel.
Paul Revere landing Park: North Bank No use of land or air rights; property widened by 70-120' feet and extended upstream 355' feet for 2.5 acre increase. Park and its setting improved for recreation use.	No use of land or air rights; property widened by 150-175 feet and extended upstream 350 feet for 4.1 acre increase. Park and its setting improved for recreation use.	No use of land or air rights; property widened by 150 feet and extended upstream 285 feet for 3.6 acre increase. Park and its setting improved for recreation use.	No use of land or air rights; property widened by 150-200 feet and extended upstream 350 feet for 4.3 acre increase. Park and its setting improved for recreation use.

At Paul Revere Landing Park South, all alternatives require use of a portion of the property, and introduce interstate highway traffic near ground level, requiring mitigation. However, all alternatives leave an adequate area for a landscaped plaza serving as a major entry to the park system, providing an opportunity for successful mitigation. The new alternatives have improved bridge designs with fewer piers and superior aesthetics. A tradeoff in this improved bridge design is a thicker bridge deck which reduces vertical clearances at the riverfront path; the area under the bridge thus requires specific mitigation in all alternatives. The alternatives differ to some extent in the width of the access way from Causeway Street; it is widest in Alternative 8.1D Mod 5 and narrowest in the Reduced River-Tunnel and Non-River-Tunnel Alternatives, which are identical in Paul Revere Landing Park South. In all alternatives, the access is sufficiently wide to provide unconstrained pedestrian and bicycle access to the park system and to accommodate official vehicles; design of mitigation measures in this access area would differ somewhat according to the available width.

Summary: This Section 4(f) Evaluation presents three new alternatives, all of which are a major improvement over Scheme Z in their proximity impacts on current MDC park property and the extent to which an integrated parkland system in this area can be successfully implemented. There are differences among the alternatives which are relatively small in the context of the overall park improvements planned by the MDC. Individual differences can be addressed through variations in the manner in which the park improvements are designed and implemented; some such aspects are discussed in the section on Measures to Minimize Harm, below. The above analysis suggests that, in the context of the systematic improvement of all parkland in the area, the three new alternatives have substantially the same effect.

3.8 Measures To Minimize Harm To Parkland In The Area North Of Causeway Street

As noted in the 1991 FSEIS Section 4(f) Evaluation, the Charles River crossing is a major feature in the Area North of Causeway Street, introducing highway structures where they are not currently present and requiring mitigation for a variety of environmental impacts, including minimization of harm to Section 4(f) properties. The 1991 Evaluation proposed a mitigation program serving the MDC's long-standing objective of improving the Charles River Basin as a part of the Metropolitan Park System, including the acquisition of significant park nodes and continuous pedestrian walkways on both sides of the river to link existing Charles River parklands with Boston Harbor. The 1991 Evaluation noted the progress to date toward this goal and stated that MHD will rely on the MDC to take a lead role in the detailed planning and design of mitigation measures and to assume ownership and control of new parklands when completed.

Key objectives in this context are the completion of continuous pedestrian/bicycle and landscape connections from Lechmere Canal Park to Charlestown Navy Yard and from the Esplanade to the Boston Harborwalk. The individual park improvements in this area are to be viewed as components in a system making the transition from the parkland in the upper basin on the west to Boston Harbor on the east. Parkland in this area derives its value from the continuity of access to and along the Charles River, from views of the river, and from areas of passive use arranged along this path system. This transition area in the Charles River park system will have a unique character based on its setting and scale. The Nashua Street and GSA parcels will be nodes at the upstream end; Paul Revere Landing Park North and South will be nodes at the downstream end; pedestrian and bicycle connections between these nodes will be given high priority.

Among the mitigation measures identified for Scheme Z was the funding of the MDC parkland master plan, which has now been substantially completed. The 1991 FSEIS/R also included a package of mitigation measures involving park improvements, based on discussions with the MDC. In general, these

measures were related to the MDC's park development objectives for the area as a whole, reducing harm to individual parklands in a variety of ways by improving the system of major parklands in the area and providing or improving connections between them so that they could fulfill their function in the areawide and regional Charles River park systems. In addition, several mitigation measures referred to improvements in the design of the highway structures so as to minimize harm through reduced impacts to the parkland resources.

Four types of mitigation measures were described in the 1991 FSEIS/R as applicable to the Proposed Action and including CANA Project Chapter 91 commitments:

Improvements To The Affected Parkland Properties

- Fully landscape Paul Revere Landing Park South
- Complete landscaping of expanded Paul Revere Landing Park North
- Develop the Nashua Street park
- Develop the park on the former GSA parcel and relocate MDC maintenance facilities
- Landscape areas of the old Charles River dam adjacent to Leverett Circle and renovate historic buildings to serve park functions for the entire area between the dams

Acquisition And Improvement Of Properties Providing Pedestrian/Bicycle Access To And Between Parkland Properties

- Lovejoy Wharf
- Access area between Causeway Street and Paul Revere Landing Park South
- Portal Park over the boat section at Causeway Street
- South bank of the river between Paul Revere Landing Park South and the MBTA commuter railroad tracks
- North bank of the river to the first highway ramp between Paul Revere Landing Park North and MBTA commuter railroad tracks
- Pedestrian path from Rutherford Avenue to the Charles River
- North Point waterfront between the MBTA commuter railroad tracks and the former GSA parcel, 100 feet wide

Structural Pedestrian/Bicycle Path Improvements To Overcome Natural And Man-Made Obstacles.

- Pedestrian overpass on the north bank at the MBTA commuter railroad tracks.
- Pedestrian walkways on both sides of the railroad bridge, connecting the existing MBTA walkways to the north bank path system.
- Walkway running longitudinally under the Green Line viaduct from Nashua Street park to the north bank.
- Pedestrian bridge across the Charles River inlet from the former GSA parcel to O'Brien Highway.
- Pedestrian underpasses at the North Washington Street bridge from Lovejoy Wharf to the North End Park and from Paul Revere Landing Park North to Tudor Wharf.

Design Refinements In The Highway Structures To Reduce Impacts To Parkland.

- Bridge and ramp design: further refinements will be made to maximize the clearance under the bridge at Paul Revere Landing Park South. Structural design, placement of columns, lighting, and architectural treatment of perimeter facade, abutment walls, underside, and columns will be

done so as to be as compatible as possible with park and pedestrian improvements and to present an acceptable appearance to abutting communities and land uses.

- Special effort will be given to the design of the under-bridge environment at Paul Revere Landing Park South, including special lighting, and appropriate uses to make the area under the bridge as positive as possible. Lowering existing ground level by 2 to 4 feet would provide greater headroom and permit the abutment wall to be moved further from the riverbank.
- Subject to design review, noise barriers will be incorporated to the extent compatible with visual impact mitigation.
- Special attention will be given to the design and location of bridge piers and appurtenances such as fender piers, escape stairs, and other structures that occupy or are visible from parkland. Pile-supported shoreline extensions will be explored in terms of design and environmental considerations in order to avoid unattractive backwaters between bridge piers or fenders and the existing shoreline, or in order to facilitate safe and attractive pedestrian and bicycle access along the shoreline.

The list of mitigation measures proposed in the 1991 FSEIS/R continues to be generally applicable to any alternative for the Charles River crossing. Some measures not considered in the 1991 Section 4(f) Evaluation may also be appropriate in place of some of the earlier identified measures to adapt to particular aspects of the three new alternatives studied in this DSEIS/R. Potential new measures to be considered include:

- Acquire and landscape the waterfront portion of the Spaulding Hospital parcel.
- Acquire and landscape the area under the loop ramp(s) between MBTA commuter railroad tracks and east edge of North Point development, which is more appropriate than a buffer area outside the loop ramps as proposed for Scheme Z.
- Provide a pedestrian overpass on the south bank at the MBTA commuter railroad tracks, taking advantage of new land on the Spaulding parcel, to the extent available, and reflecting possible impacts to future MBTA air rights development which was previously assumed to provide a southbound overpass.
- At Paul Revere Landing Park South, in the Reduced River-Tunnel and Non-River-Tunnel Alternatives, improvements to the approach to the current park property will be developed to address the point where the riverbank is closest to the highway structure. An L-shaped extension of Lovejoy Wharf to this area would provide additional width for separation of pedestrians and bicycles as well as additional amenities; further design studies of this area will be presented in the FSEIS/R.
- At Leverett Circle, continued attention will be given to the design of the intersection, with the objective of providing an appropriate at-grade entrance to the Nashua Street park from the Esplanade through the first arch of the historic Green Line viaduct, as proposed in the MDC master plan.
- In the Non-River-Tunnel Alternative, efforts will be made to avoid the encroachment of Nashua Street into the Nashua Street parcel.

All previous and new potential measures should be considered together in developing the mitigation package which best minimizes harm for the new alternatives. A final list of proposed mitigation will be determined in the FSEIS/R based on the alternative selected. Since the impacts of the new alternatives are substantially similar, the overall mitigation package will also be substantially similar regardless of which alternative is chosen.

In addition to the final mitigation measures, the design modifications incorporated in the three new alternatives to Scheme Z specifically represent further progress towards minimization of harm. The

development of these design alternatives should be viewed as a new approach which qualitatively goes beyond the mitigation measures previously committed by MHD. This new approach of substantially modifying the Charles River crossing design is not a substitute for park improvements needed to minimize the harm of any Charles River crossing alternative, as all alternatives use parkland and have visual and noise impacts that affect pedestrians and park visitors. Rather, the new design alternatives provide a complementary approach to mitigation. Briefly stated, the new alternatives mitigate the impacts of Scheme Z by reducing the height and number of loop ramps on the north bank of the river, by providing superior bridge designs, and by avoiding double river crossings of traffic between the Central Artery and Leverett Circle; these changes substantially reduce Scheme Z's visual and noise impacts and better serve to achieve a well-used future open space system along the banks of the river.

Given the substantial improvement of MDC parkland to be achieved through implementation of systemwide parkland mitigation measures and the further substantial reduction in harm due to the design improvements common to all three alternatives to Scheme Z, the small differences in impact and degree of improvements among these three alternatives will not result in functional differences in the completed parkland system. These alternatives when mitigated are essentially equivalent in the reduction of Section 4(f) impacts.

MHD will continue to work with the MDC to implement their previously executed MOA, addressing, among other issues, the budget for park mitigation within the context of the master plan. While MHD recognizes and endorses the general concepts of the master plan as reflecting the MDC's park objectives for this area, specific elements of park design remain to be resolved at this time, some of them relevant to the environmental permitting process. MHD will cooperate with the MDC, the cities of Boston and Cambridge, and the permitting agencies in addressing such questions as they affect properties under MHD's control during construction. As provided in the MOA, the MDC will be responsible for the design, environmental permitting, and construction of those mitigation improvements which are funded by MHD but are outside the Project work limits.

Construction Period Mitigation. MHD's objective is to minimize disruption and maintain continuous navigation through the locks and pedestrian access over the locks during construction, as well as continuous pedestrian access to the Esplanade. Preliminary staging plans for each design are presented in Chapter 5 of this DSEIS/R. Further effort is necessary to develop detailed construction staging plans for the preferred alternative, once selected, and will be presented in the Supportive Engineering Report of the FSEIS/R. As pre-mainline mitigation improvements are planned with the MDC, effort will be made to develop construction staging plans to avoid or minimize disturbance to these early park improvements.

3.9 Bunker Hill Community College Athletic Facilities

Scheme Z And New Design Alternatives. Scheme Z does not extend onto BHCC property. All new alternatives have an identical northbound off-ramp to Rutherford Avenue. This ramp crosses the property on viaduct, passes between the College's tennis courts and ball fields, reaches local ground level near the softball field, and descends to Rutherford Avenue, at an elevation approximately 10 feet below the level of the ball fields.

Description Of Section 4(f) Property. The athletic facilities at the north end of the campus comprise approximately 9 acres and include a baseball field and a softball field surrounded by an asphalt jogging path, and four tennis courts. The baseball field and softball field are oriented in opposite directions, with home plates approximately 720 feet apart and a large common outfield area. A soccer field is located in the common outfield area between the ball fields. The jogging path is 8 feet wide and approximately

2,200 feet in length. These facilities are intended to be used by BHCC students and staff, although, according to college administrators, community use of ball fields and tennis courts is permitted, and some use occurs. The setting of the athletic facilities includes the BHCC academic buildings to the south, the I-93 viaduct to the west, an industrial area to the north, and Rutherford Avenue and the edge of the Charlestown community to the east. No Section 6(f) funds were used in the development of these facilities.

Impacts On The Section 4(f) Property. In the three new alternatives, a one-lane viaduct off-ramp (Ramp C-L) passes within 35 feet of the four existing tennis courts. The ramp passes over the existing path to the tennis courts with a clearance height of approximately 15 feet; therefore, access is not impeded. The ramp reaches grade at the College's ballfields and jogging path, requiring relocation of the path and the north ball field. As the ball fields are located on an embankment, the ramp descends below the grade of the ball fields, reaching Rutherford Avenue approximately 10 feet below. Total use of land in the athletic field area of the College would be approximately 1 acre at the ball fields plus 0.5 acre of unprogrammed land between the ball fields and the tennis courts (see Figure 9).

Adequate land is available to reconfigure the softball field in question as described below under measures to minimize harm. After reconfiguration, the athletic fields will be fully usable for regulation play, the jogging path will continue to be usable as today, and access to and use of the tennis courts will not be affected; consequently, no loss of function will occur. There will be a change in setting due to views of the off-ramp, but this change does not affect the values and functions of an active sports facility, particularly in a setting of which the elevated I-93 viaduct is already part.

As described in Section 4.4 of this DSEIS/R, noise levels are essentially the same in all alternatives (within 2 dBA of Scheme Z). There is little or no change in air quality due to the off-ramp (see Section 4.3).

Avoidance Alternatives. Scheme Z locates the northbound Central Artery off-ramp C-L at City Square, carrying a large volume of traffic to regional arterial streets and resulting in peak hour intersection volumes that significantly exceed the capacity of the intersection, resulting in a degree of failure that is substantially beyond acceptable limits. The delays experienced in this intersection are significantly worse than in other intersections in the City with LOS F, in part because City Square is a key node in the city's traffic network, and 70 percent of trips carried by the C-L ramp are destined for Sullivan Square, Route 28 in Somerville, or Route 99 in Everett, and have no practical alternative route to Rutherford Avenue. If the ramp were at City Square in the Reduced River-Tunnel and Non-River-Tunnel Alternatives, volumes at City Square would be the same as in Scheme Z (in Alternative 8.1D Mod 5, which has a single Tobin-to-Central Artery loop ramp, an off-ramp to City Square is not possible).

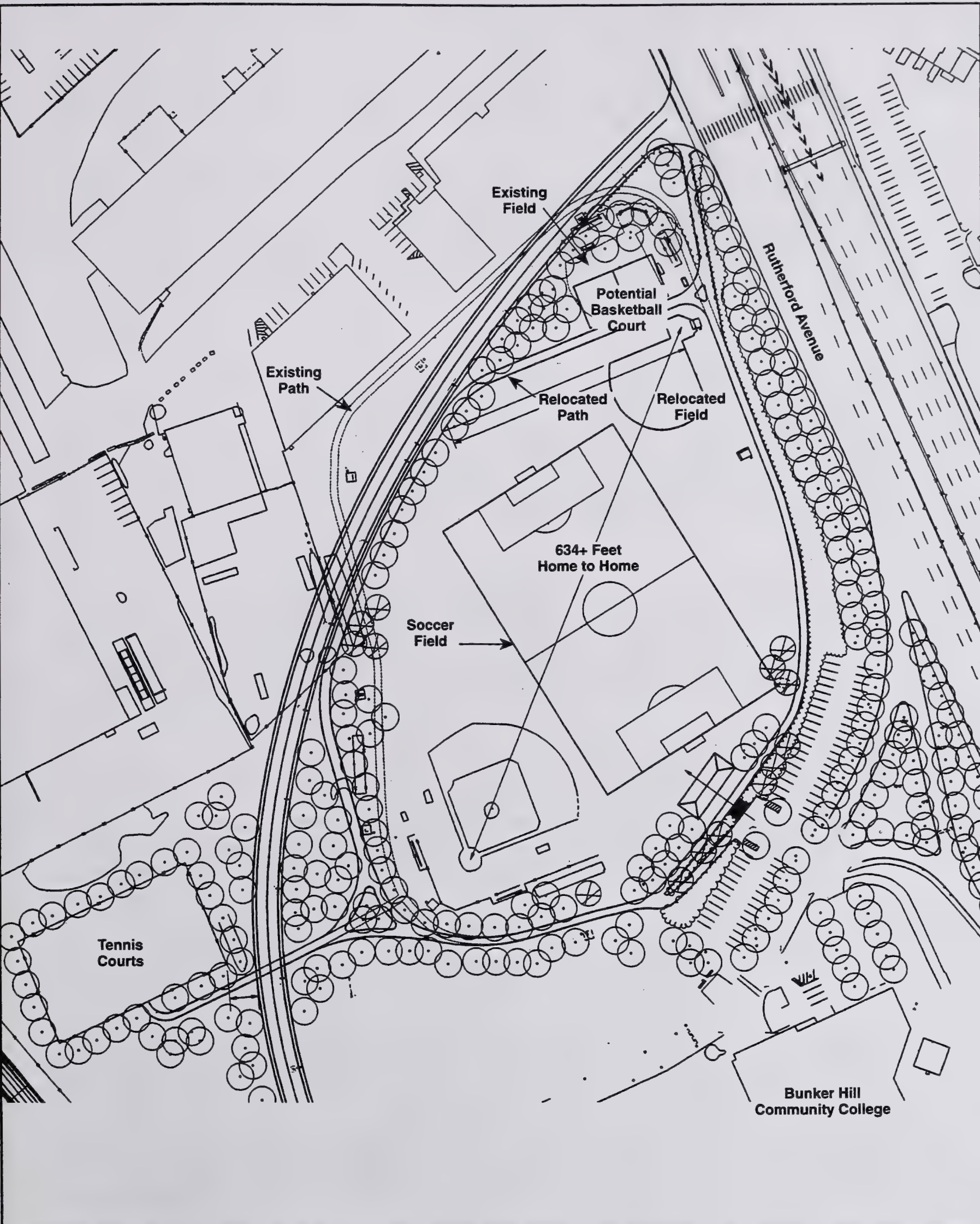
In addition to causing unacceptable traffic conditions at City Square, an off-ramp at this location in the Reduced River-Tunnel and Non-River-Tunnel Alternatives would occupy land adjacent to Paul Revere Landing Park North, reducing its expansion by 1.3 to 1.8 acres and introducing heavy surface traffic volumes at the north edge of the park, with impacts on the park as in Scheme Z. Air quality improvements, described above, would be lost. Pedestrian access to Paul Revere Landing Park and vehicular access to the NPS facilities in the Charlestown Navy Yard, including the U.S.S. Constitution, would also be impeded by heavy traffic in City Square. The improvement of City Square, which has been a major objective of the CANA project, now being completed, and the planned City Square Park, being currently undertaken separately in conjunction with the CANA project, would be adversely affected by these impacts. In addition, Keany Square, next to the Causeway/North Washington Streets Historic District and the North End Historic District, would remain congested as in Scheme Z.

Elimination of the C-L ramp was considered. If the ramp were eliminated altogether in the new alternatives, the demand for access to northern destinations via Rutherford Avenue would shift from the Central Artery to the local street system, resulting in a 32 percent increase in traffic over the North Washington Street bridge (compared to traffic with the C-L ramp at BHCC); congestion at City Square would be nearly as severe as with a C-L ramp at City Square, and, in addition, Keany Square in the North End would become more severely congested than in Scheme Z. Traffic increases on North Washington Street would adversely affect the North End and Causeway/North Washington Streets Historic Districts (described under 4(f) Historic Resources, below); and traffic on Rutherford Avenue would be 27 percent higher than with the ramp at BHCC, adversely affecting the Town Hill Historic District and impeding pedestrian crossings to Paul Revere Landing Park North. Rearranging the location of ramps in the vicinity of City Square was also considered (for example, trading the locations of the C-L ramp with the Tobin Bridge to City Square ramp), but this would lead to only minor improvements in the degree of congestion at City Square.

Alternative ramp locations farther from City Square were also considered. Because of the high proportion of traffic destined for Sullivan Square, Somerville, and Everett, the locations of the existing underpass to Everett and the overpass to Route 28 in Somerville are key constraints. Locations south of the Gilmore Bridge are either geometrically infeasible (i.e., in conflict with other structures), or are substantially equivalent to the City Square off-ramp location as described above. The Gilmore Bridge is not a feasible location because of heavy existing and future traffic volumes there. North of the Gilmore Bridge the BHCC property provides the only opportunity for a ramp location south of the entrance to the underpass to Everett. As locations progressively farther north of the BHCC property are considered, it becomes increasingly difficult to design an intersection which permits traffic to reach the underpass (even if the underpass were reconstructed). Most of this traffic would return to the local street system if denied this connection. Location of the ramp terminus at the industrial A Street, 200 feet north of the College property, would not completely avoid the athletic fields, as ramp geometry would place the alignment over the tennis courts. Other locations for the ramp in this industrial area north of BHCC continue to be investigated, although difficult because of existing development and geometrical difficulties in connecting to the existing underpass and overpass at Rutherford Avenue. The final opportunity for the ramp is Sullivan Square, where it would intersect with Cambridge Street, causing congestion at the Sullivan Square intersection and conflicting with vehicular access and egress to and from the MBTA Orange Line station. A ramp at Sullivan Square would result in similar levels of congestion in Keany Square as in Scheme Z. Efforts are continuing to develop and evaluate refinements to the ramp alignment which would reduce or avoid impacts at the BHCC athletic field; results will be presented in the FSEIS/R. Consultation with BHCC and HECC will continue during the period leading up to the FSEIS/R.

Summary: Elimination of the C-L ramp or its location at City Square would fail to satisfy a basic Project objective of removing regional traffic from local streets, and it would have adverse effects on the City Square urban environment and on Section 4(f) resources including Paul Revere Landing Park by increasing traffic, reducing air quality, impeding access, and limiting expansion of parkland.

Relationship To MDC Parkland System. Bunker Hill Community College's athletic facilities are affected identically by all three new alternatives. Relocation of the local off-ramp from the Central Artery from City Square is a net benefit for 4(f) protected parkland as a whole because it permits substantially greater expansion of Paul Revere Landing Park North, reduces impacts to that park, and facilitates pedestrian access to it and to the Charles River by reducing traffic volumes in City Square and on Rutherford Avenue, which Charlestown residents must cross to reach the Charles River. In addition the BHCC ramp location improves vehicular access to the NPS facilities at Charlestown Navy Yard, substituting a slightly longer but freer-flowing route along Rutherford Avenue for a shorter but severely



FIGURE

9

Use Of Section 4(f)
 Resource: Bunker Hill
 Community College
 Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
 CENTRAL ARTERY/TUNNEL PROJECT



congested route via City Square. The impacts to the BHCC facilities can be mitigated by reconfiguration of the affected softball field and jogging track.

Measures To Minimize Harm. There is adequate space to relocate the north ball field to provide a regulation foul line distance for softball of 275 feet. The required 275-foot foul line (for regulation fast-pitch softball) can be provided by moving the diamond approximately 100 feet to the south. This would leave a separation of 600 feet between the home plates of the facing ballfields, adequate for safe play on both fields at the same time and adequate for a soccer field between the ball diamonds. The field reconfiguration would shorten the 2,200-foot jogging path by 100 feet.

4 HISTORIC RESOURCES

This section addresses historic resources protected by Section 4(f) which are used by Scheme Z or one of the new alternatives. Section 4(f) protects buildings that are listed or eligible to be listed on the National Register of Historic Places, and contributing buildings or land within historic districts that are listed or eligible for listing. This Section 4(f) Evaluation addresses a narrower range of issues than the assessment presented in Section 4.7.1 of this DSEIS/R, where all effects on historic resources are considered. Section 4(f) requires specific analysis and findings by FHWA where there is actual use of a historic resource or adverse effects sufficiently serious to substantially impair the values and attributes of the resource (i.e., constructive use).

Scheme Z uses portions of three resources: land within the Charles River Basin Historic District, Railroad Signal Tower A, and (temporarily) the granite seawalls along the Charles River under its I-93 bridges. (The seawalls in this area were identified for the first time as eligible for listing by MHC in the months preceding the publication of this DSEIS/R.) Three other resources were documented in the 1991 Section 4(f) evaluation as not being used by Scheme Z: the Causeway/North Washington Streets Historic District, Charles River Railroad Drawbridge, and Town Hill Historic District.

One or more of the new alternatives use four resources: land within the Charles River Basin Historic District, railroad signal Tower A, the Registry of Motor Vehicles building (underpinning), and (temporarily) the granite seawalls along the Charles River. For continuity, the Causeway/North Washington Streets Historic District, Charles River Railroad Drawbridge, and the Town Hill Historic District are briefly addressed in this Section 4(f) Evaluation, as well as the North End Historic District, in which there is a brief temporary disturbance and restoration of historic pavement at Stillman Place by all new alternatives.

In all cases, the 1984 Section 106 MOA, signed by FHWA, MHC, Boston Landmarks Commission, and MHD, provides for review of design and construction plans by the Project Conservator to ensure that potentially adverse construction impacts on 4(f) resources are minimized or avoided.

Section 4(f) also protects archaeological resources eligible for listing on the National Register. A preliminary Phase I Reconnaissance survey was performed in the areas affected by the new alternatives and not previously inventoried (see Section 4.7.2). No known archaeological resources have been identified in areas affected by any of the Charles River crossing alternatives, and therefore no 4(f) use of any archaeological resource is anticipated. New soil borings and geotechnical analyses will be monitored for archaeological data as they become available. Should evidence of significant archaeological resources be detected, plans for avoidance, preservation, or data recovery, as appropriate, would be developed with MHC, pursuant to the Section 106 MOA.

Location of resources described above are shown in Figure 10.

4.1 Charles River Basin District

Scheme Z And New Design Alternatives. In Scheme Z and all three alternatives, Leverett Circle is reconfigured, and in all alternatives except 8.1D Mod 5, the curb line of Storrow Drive is moved outward. Also, the existing surface lanes continue to pass under the first arch span of the historic Streetcar Railway Viaduct.

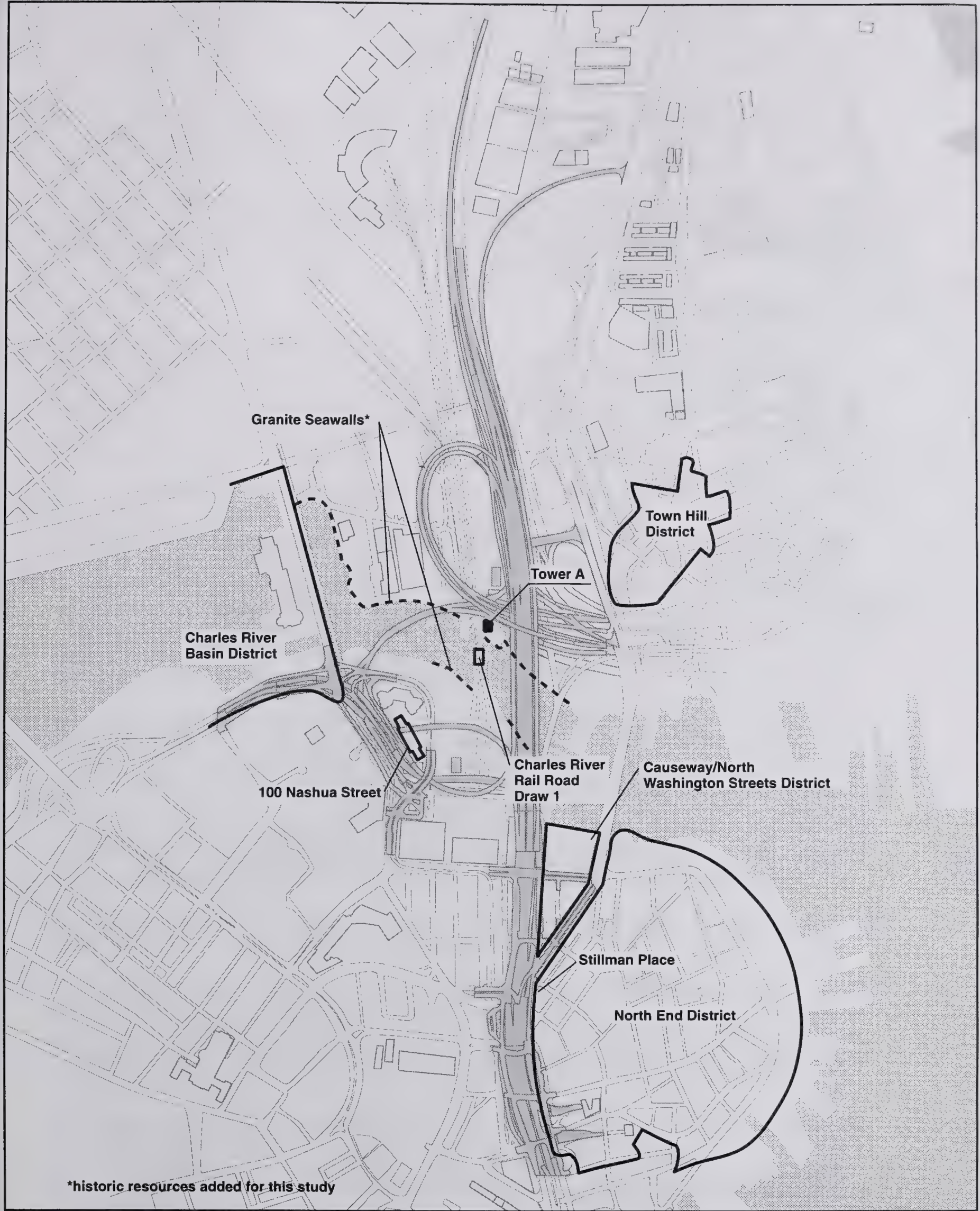
Description Of The Section 4(f) Property. The Charles River Basin National Register district incorporates the Charles River and the parkways and landscaped areas on both banks for approximately 6 miles upstream from the old Charles River dam (carrying the O'Brien Highway) to the Elliot Bridge in Cambridge. Owned and maintained by the MDC, its significance is based on the history of metropolitan park planning and land reclamation in the Charles River Basin, as well as the architectural merit of several features. The contributing elements of the district which are within or adjacent to the Project area include the Esplanade (recreation), the old Charles River dam (land reclamation), the Police Headquarters and Lock houses (relationship to the dam and architectural merit), and architecturally significant Street Railway Viaduct (carrying the MBTA Green Line). Storrow Drive and Leverett Circle, also lying within the district, are described as physical features of the district in the National Register nomination, but not mentioned in its discussion of the district's significance. (Leverett Circle Storrow Drive, and the Esplanade are also discussed in the Parkland section of this Section 4(f) Evaluation.)

Impacts On The Section 4(f) Property. In Scheme Z, a total of 0.57 acre of land is converted from roadway to landscaping or from landscaping to roadway as part of the redesign of the Leverett Circle intersection and the widening of Storrow Drive on the opposite side from the Esplanade. These changes do not affect the contributing features of the district, such as the Street Railway Viaduct and historic buildings at the dam, and do not change its visual character.

All new alternatives affect the district in the same manner as Scheme Z, using varying amounts of land. None permanently affects contributing features within the district. Alternative 8.1D Mod 5 has no eastbound underpass at Leverett Circle and therefore does not change in the southeast curb line of Storrow Drive; it changes a total of 0.42 acre of pavement to landscaping or landscaping to pavement. The Reduced River-Tunnel and Non-River-Tunnel Alternatives have different eastbound underpasses but widen Storrow Drive by the same amount as Scheme Z. Total use of land in the district is 0.63 acre in the Reduced River Tunnel-Alternative and 0.59 acre in the Non-River-Tunnel Alternative. (The above figures include the total of areas changed by the alternatives, whether converted to pavement or to landscaping.) Although there are differences among these alternatives in the presence or absence of an eastbound underpass and its configuration, these differences do not affect the historic attributes and values of the district, as Storrow Drive and Leverett Circle are not contributing features. (Refer to the section on Leverett Circle/Storrow Drive in the Parkland section of this Section 4(f) analysis.)

As described above under Parkland and in more detail in Section 4.4 of this DSEIS/R, changes in year 2010 noise and air quality among the alternatives are small, and the contributing features of this part of the district are not particularly sensitive to these impacts. The projected changes in noise and air quality do not substantially impair or diminish the attributes of the districts contributing features in any alternative.

Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative involve construction of a tunnel connection near the first arch of the historic Street Railway Viaduct. No impacts are anticipated, as this construction procedure is properly planned and controlled under the supervision of the Project Conservator. Other temporary construction impacts are similarly controlled and minimized in all alternatives. All construction work takes place outside the Esplanade.



FIGURE

10

Historic Resources Addressed Section 4(f) Evaluation Charles River Crossing DSEIS/R

MASSACHUSETTS HIGHWAY DEPARTMENT
CENTRAL ARTERY/TUNNEL PROJECT

0 200 400 600 800 1000 FEET



Avoidance Alternatives. As discussed in the 1991 Section 4(f) Evaluation, connection to Storrow Drive is a principal design objective of the Project; therefore, use of this MDC property, which lies within the district, cannot be avoided. However, there is no long-term adverse effect on the historic district.

Measures To Minimize Harm. Construction of tunnels near the historic Street Railway Viaduct will be carefully reviewed under the Section 106 MOA. Any potential adverse effects from construction are mitigated through review of design and construction specifications by the Project Conservator.

4.2 Tower A

Scheme Z And New Design Alternatives. Scheme Z has loop ramps directly over Tower A and a double-deck Storrow Drive connector bridge in the vicinity of the building. Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative have tunnels near the building but have reduced loop ramps located 35 feet away in Alternative 8.1D Mod 5 and 85 feet away in the Reduced River-Tunnel Alternative. The Non-River-Tunnel Alternative has no tunnel in the vicinity; its loop ramps and its single-deck Storrow Drive connector bridge are 35 and 70 feet away from the building, respectively.

Description Of The Section 4(f) Property. Tower A is a two-story, rectangular steel frame and brick signal tower with full-story brick and copper five-sided bays on the north and south elevations. A one-story brick flat-roofed addition runs the full width of the east elevation. The structure was built during the Boston and Maine Railroad's 1926-32 construction of the Boston Engine Terminal and replaced an earlier structure on the south side of the railroad bridges. It was placed in service in 1931. It is equipped with an electrical board with 211 levers. Tower A is considered eligible for listing on the National Register as a distinctive example of railroad architecture. It is the only remaining unaltered building from the B&M expansion of the Boston Engine Terminal. It is also significant for the signal technology used in the tower. Tower A serves the same function today.

Impacts On The Section 4(f) Property. In Scheme Z, overhead CANA ramps pass within 2 to 4 feet above the roof of the building, and a line of columns blocks views from the building to the railroad tracks. Thus, the setting of the building is drastically altered, and the relationship between the building and the railroad tracks, which is an attribute central to the historic significance of the building, is destroyed. (At the time of the 1991 Section 4(f) Evaluation it was uncertain whether foundation construction for Scheme Z would adversely affect the building structurally; it is now concluded that this is not the case, although some impacts requiring mitigation might occur.) For these reasons, the 1991 Section 4(f) Evaluation concluded that the building would be permanently used by Scheme Z.

All three new alternatives avoid direct use of the building exterior and would substantially reduce the visual impacts to Tower A's setting from those in Scheme Z.

Alternative 8.1D Mod 5 removes the CANA project ramp impact by eliminating the outer loop ramp; the remaining viaduct loop leading to I-93 southbound (Ramp T-C) is 85 feet from Tower A, and the closest supporting column would be 100 feet to the north. The tunnel leading to I-93 northbound (Ramps C-T and S-N) passes within 15 feet of the building, and an exhaust duct for the tunnel passes directly under Tower A, requiring permanent subsurface use and underpinning during construction.

The Reduced River-Tunnel Alternative eliminates the CANA project ramp impact by relocating the viaduct loop connecting I-93 northbound and Route 1 northbound (Ramp C-T) 35 feet away from Tower A. Columns supporting the highway viaducts are located 15 feet east of the rear of the building; four others are located 90 to 150 feet away north, near the railroad tracks. These viaducts and columns have substantially less impact than Scheme Z and have little effect on the Tower's setting and relationship to

the railroad tracks. The tunnel leading to Route 1 northbound (Ramp S-N) passes within 20 feet of this building. Therefore, there is no subsurface use and underpinning is not likely to be required.

The Non-River-Tunnel Alternative eliminates this CANA project ramp impact in the same manner as in the Reduced River-Tunnel Alternative. A single-deck Storrow Drive connector bridge is located 70 feet downstream from the building and does not affect the Tower's relationship to the railroad tracks. A column supporting the Storrow Drive connection highway viaduct is located 100 feet east of the building; three others are located 65 to 85 feet north of the building, near the railroad tracks. These viaducts and columns are substantially reduced from Scheme Z and have little effect on the Tower's setting. Therefore, no use of the resource would occur.

Avoidance Alternatives. The Reduced River-Tunnel and the Non-River-Tunnel Alternatives avoid any permanent use of the resource and reduce changes in the building's setting and sightlines to the point where no constructive use occurs.

Measures To Minimize Harm. Potential adverse effects due to construction will be mitigated through review of the design and construction specifications by the Project Conservator.

4.3 Granite Seawalls In The Lower Basin Of The Charles River

Scheme Z And New Design Alternatives. Scheme Z and all new alternatives have bridges over or near a portion of the granite seawall on the north and south banks of the Charles River downstream from the railroad crossing; construction of large footings for these bridges would temporarily disrupt these seawalls in the immediate vicinity. Two alternatives, 8.1D Mod 5 and the Reduced River-Tunnel Alternative, have river tunnels under the seawall on the Cambridge side of the river.

Description Of The Section 4(f) Property. There are several lengths of granite seawall between the Charles River dams. Although some portions of these seawalls are affected by Scheme Z, they have only recently been identified as potentially eligible for the National Register by the Cambridge Historical Commission and MHC have identified. A determination of eligibility is expected by the time of publication of this Draft SEIS/R. These resources include a nearly continuous granite seawall on the northern (Cambridge) side of the river, which extends from the Railway Viaduct to the dam, and fragments of a granite seawall on the southern edge of the river, near the North Station platforms and Spaulding Hospital and on the northern edge of the river between the railroad crossing and the new dam. Although these seawalls were not included in the Charles River Basin District, they are believed to be similar to features in that district though of later date, and thus are considered historically and architecturally significant.

Impacts On The Section 4(f) Property. Scheme Z and all new alternatives would require the reconstruction of a portion of seawall on the north bank near the outlet of the Millers River in order to construct a footing for their respective highway bridges. Scheme Z, the Reduced River-Tunnel Alternative, and the Non-River-Tunnel Alternative require reconstruction of a portion of seawall just upstream of Paul Revere Landing Park on the south bank for the same purpose. In all instances, less than 100 lf of seawall are dismantled and construction of footings and cofferdams at the riverbank occurs; temporary construction structures are then removed and the seawalls replaced in their existing condition. There is no long-term impact on the seawalls. Therefore, temporary use of the granite seawalls occurs in all alternatives, including Scheme Z.

In Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative, construction of the river tunnel requires removal of the granite seawall located on the north side of the river, between the railroad bridge

and the Street Railway Viaduct. Following construction, the seawall can be reconstructed in place in its existing condition. Alternative 8.1D Mod 5 crosses the seawall at an acute angle affecting 250 lf; the angle is less acute in the Reduced River-Tunnel Alternative, affecting 150 lf. These uses of the 4(f) resource are also temporary.

Avoidance Alternatives. Because the alignment of I-93 is highly constrained, and because it is necessary to avoid placement of piers in the river where they interfere with navigation, it is not possible to avoid temporary use of short portions of seawall near the bridge piers during their construction. Scheme Z and Non-River-Tunnel Alternative avoid the segment of seawall located upstream of the railroad crossing. Additional design refinements to the Reduced River-Tunnel Alternative currently being studied (described in Section 2.6.2 of this DSEIS/R) have the potential to relocate this alternative's river tunnel downstream of the railroad crossing; however, this refinement would temporarily use a portion of the granite seawall on the south bank of the river. The extent and duration of disruption may be sufficiently limited as to constitute no 4(f) use, particularly for the alternatives without river tunnels.

Measures To Minimize Harm. Potential adverse effects will be mitigated through review of the design and construction specifications by the Project Conservator, and through reconstruction of the granite seawalls in a manner similar to that prescribed in the 1984 MOA for seawalls affected by Project construction at Fort Point Channel.

4.4 100 Nashua Street (Registry Of Motor Vehicles Building)

Scheme Z And New Design Alternatives. Scheme Z does not affect this resource. All new alternatives have a southbound tunnel from Storrow Drive to the Central Artery and the Callahan Tunnel which passes under the building.

Description Of The Section 4(f) Property. The Registry building is an eight-story public office building designed by Edward P. Graham and built in 1932. The building, clad with cast stone with aluminum spandrels, is a significant example of Depression-era public architecture. It is notable for its distinctive design and detailing characteristic of that period. While the building is structurally sound, the attachment system for its stone cladding has deteriorated leading to the loosening of facade panels.

Impacts On The Section 4(f) Property. Scheme Z was determined to require no long-term use or short-term impacts on the building. In all new alternatives, the tunnel leading from Storrow Drive to I-93 southbound passes directly under this building, requiring permanent subsurface use of the building and underpinning during construction. The extent of impact is essentially equal in the three alternatives and can be fully mitigated as described below. In addition, an at-grade roadway leading to Nashua Street (Ramp N-L) passes within 20 feet of and parallel to the entire length of the rear of the building, and has some effect on the visual setting of the building, but this visual impact is not of a magnitude to substantially impair the values and attributes of this building.

In Alternative 8.1D Mod 5, there is an above-ground ventilation building with eight exhaust air discharge stacks, located across Nashua Street on the Spaulding Hospital site, 230 feet away (see Chapter 2 for a discussion of ventilation building location and configuration). The presence of this structure does not significantly affect the setting of the Registry building, which has from the beginning been surrounded by a variety of scales and types of structures, including the Storrow Drive connector viaduct and adjacent Minot Station steam plant.

In the Reduced River-Tunnel Alternative there is a below-grade ventilation structure with four exhaust air discharge stacks, located across Nashua Street 230 feet to the east. In the Non-River-Tunnel

Alternative, there is a below-grade structure with four exhaust-air discharge stacks, located across Nashua Street 300 feet to the east. As discussed in the preceding paragraph, these structures do not significantly affect the visual setting of this building.

Design refinements involving reconfiguration of Leverett Circle, to Alternative 8.1D Mod 5 and the Reduced River-Tunnel Alternative, are discussed in Section 2.6.1 and 2.6.2 of this DSEIS/R. These refinements would modify connections to Storrow Drive, including a ramp from Nashua Street with a boat section in the current location of the Registry building. Such a refinement would therefore require the demolition of this 4(f) resource.

A second design refinement to the Reduced River-Tunnel Alternative, as discussed in Section 2.6.2 of this DSEIS/R, would relocate that alternative's river tunnel, potentially requiring the underpinning of the Registry building's southwest corner. This additional underpinning, if required, could be accomplished in the same manner as described above, with no long term damage to the building.

Avoidance Alternatives. Like Spectacle Island, a Section 4(f) parkland resource evaluated in the 1991 Section 4(f) Evaluation, 100 Nashua Street is an unusual application of Section 4(f). Because the building is currently endangered by the deterioration of the attachment system for its stone cladding, preservation of the key historic attributes of the building requires affirmative remedial action, namely, stabilization or reattachment of the facade. Due to the great magnitude of the cost of facade reattachment, and the absence of State or Federal funds for this purpose, the new alternatives for crossing the Charles River offer, in effect, the best chance for preservation of the resource.

Thus, while Scheme Z avoids the building, it is highly probable that the effect of avoiding the resource would be its demolition in the near term owing to safety concerns about the deteriorating facade and the very high cost of repair in relation to the economic value of the building. Conversely, the use of the building by the new alternatives, which have tunnels under it, results in little or no long-term adverse effect to the attributes for which it is historically significant. Because this requires the stabilization of the building's architecturally significant facade, a positive benefit therefore results. In this instance, avoidance does not minimize harm to the property as Section 4(f) intends.

Measures To Minimize Harm. In all new alternatives, the building is underpinned by placement within the basement of the building of transverse beams which transfer the foundation loads to new caissons, also to be constructed from within the building basement. This underpinning method would not require discontinuation of building use during construction. The building facade attachment system, which is deteriorated and allowing the facade cladding to become detached from the building, is stabilized during the construction process, and, if necessary, replaced. These operations, as well as construction effects such as dewatering and vibration, will be managed and mitigated through review of design and construction specifications by the Project Conservator. Construction documents for the stabilization or reattachment of the building's facade will be prepared in consultation with MHC and reviewed by the Conservator.

4.5 Historic Resources Not Used By Scheme Z Or New Design Alternatives

4.5.1 Causeway/North Washington Streets District

In the 1991 Section 4(f) Evaluation, Scheme Z was determined not to use or constructively use areas within this district, although there is traffic impact due to increased volumes on North Washington Street, owing to lack of a downtown northbound on-ramp, and the district's setting would be affected by the Scheme Z's Charles River bridges.

None of the new alternatives uses any portion of the district, and all enhance its setting by reducing traffic volumes on North Washington Street and by substituting improved bridge designs. Measures to minimize harm to parklands, including improvements to Lovejoy Wharf and the area between the Charles River and Stop and Shop buildings and the I-93 boat section, would also benefit the district.

4.5.2 North End District

Scheme Z And New Design Alternatives. Scheme Z removes the existing six-lane Central Artery viaduct which has noise and visual impacts on this district, replacing it with an eight-lane tunnel and also depressing connections between the Central Artery and the Callahan/Sumner Tunnels. Three boat sections are located at New Sudbury Street outside the district, approximately 90 feet away from the closest contributing structures in the district, five row houses at Stillman Place. A three-lane surface artery forms an intersection with Stillman Place and is located 35 feet from the closest row house.

All new alternatives are similar to Scheme Z in the vicinity of the district, but all have a modified design at New Sudbury Street which introduces an additional boat section. This boat section is located 40 feet from the Stillman Place row houses and is necessary to reincorporate the northbound downtown on-ramp which was deleted from Scheme Z between the 1990 DSEIS/R and the 1991 FSEIS. This change, while reducing traffic along the edge of the North End district, also causes a two-lane Surface Artery to be located approximately 27 feet closer to the district than in Scheme Z, or 8 feet from the corner of the nearest row house at Stillman Place.

Description Of The Section 4(f) Property. One of Boston's oldest residential neighborhoods, the North End is a densely built and visually cohesive neighborhood, first settled in the 1630s and heavily developed through the early twentieth century. Stillman Place is a narrow street with historic paving materials and five historic, Federal-period row houses (2-6 Stillman Place) facing a parking lot and the existing Central Artery viaduct, 20 to 65 feet away. The row house units, together with the historic pavement and bollards along Stillman Place, are contributing structures in the district.

Impacts On The Section 4(f) Property. Scheme Z does not use any part of the district and has a long-term benefit on its setting by removing the existing Central Artery viaduct which borders it. The absence of a downtown northbound on-ramp in Scheme Z results in heavier traffic volumes on the Surface Artery and North Washington Street, affecting contributing structures along the edge of the district.

None of the new alternatives permanently uses any portion of the district. All new alternatives have the potential to displace temporarily up to 300 square feet of historic paving materials (granite pavers and granite bollards at the curb line) during construction of a new intersection of the Surface Artery with Stillman Place. This construction period impact is of limited extent and brief duration during the construction phase involving surface street construction. As in Scheme Z, the outer slurry wall of the Central Artery northbound tunnel passes within 15 feet of the row houses at 2-6 Stillman Place. Slurry wall construction was selected as a technique to minimize or avoid structural damage to historic buildings along the Central Artery and does not damage the Stillman Place row houses or other contributing features of the district.

In the new alternatives, the Surface Artery is reduced from three to two lanes in this area, but located closer to the edge of the district. This new city street passes within 8 feet from the corner of the closest of the historic row houses and 40 feet from the farthest row house unit. Daily traffic would be at least 15 percent lower on the Surface Artery in the new alternatives compared to Scheme Z and PM peak hour traffic at least 30 percent lower. These reductions in traffic benefits the North End District as a whole.

The proximity of the new surface road to the Stillman Place row houses an adverse effect on their visual setting, but is a substantial improvement over the existing setting of these urban row houses, which currently face the elevated Central Artery and a surface parking lot. This impact is not so severe as to substantially impair the resource.

Because the temporary use of historic paving materials is brief and of limited extent, and because the changes in setting do not substantially impair the Stillman Place row houses, no use or constructive use of district occurs.

Avoidance Alternatives. As discussed above, no use of the district occurs in any alternative.

Measures To Minimize Harm. All alternatives have an overall long-term positive effect on the district as a whole and on Stillman Place, by removing the existing Central Artery viaduct and thereby enhancing the district's setting. The new alternatives reduce the proximity impacts of traffic on the district as a whole compared to Scheme Z. During further design refinement of the northbound on-ramp at New Sudbury Street, MHD will attempt to increase the distance between the Surface Artery and Stillman Place. Landscaping will be used to mitigate effects on the historic paving materials and the row house units. Surface Artery joint development guidelines for this area will contain preservation criteria to enhance the character and integrity of the district. Construction effects such as dewatering and vibration will be mitigated through review of design and construction specifications by the Project Conservator, as for other historic buildings along the alignment. The disturbance to historic paving materials at Stillman Place will be minimized, and any materials removed will be stored and replaced in the existing condition.

4.5.3 Charles River Railroad Draw 1

This railroad bridge is one of the last remaining Scherzer rolling lift bridges in the state. It is regularly used and is controlled from Tower A, which is described above. Neither Scheme Z nor the new alternatives has any effect on this resource, which is significant only for its engineering design. In particular, because of adequate distances from Project elements, there is no effect due to the river tunnels in Alternative 8.1D Mod 5 or the Reduced River-Tunnel Alternative, nor from the Storrow Drive connector bridge in the Non-River-Tunnel Alternative.

4.5.4 Town Hill Historic District

This district, adjacent to City Square, contains residences and civic buildings significant to the history of development of Charlestown. There is no use or constructive use by Scheme Z, which is located more than 600 feet outside the district. In the three new alternatives, there is also no use or constructive use, as the I-93 viaduct and connecting ramps will be lower, fewer in number, and farther from the district. A tunnel element in Alternative 8.1D Mod 5 is sufficiently removed from the district (approximately 200 feet) to require no temporary use during construction.

